

CHEMICAL & METALLURGICAL ENGINEERING

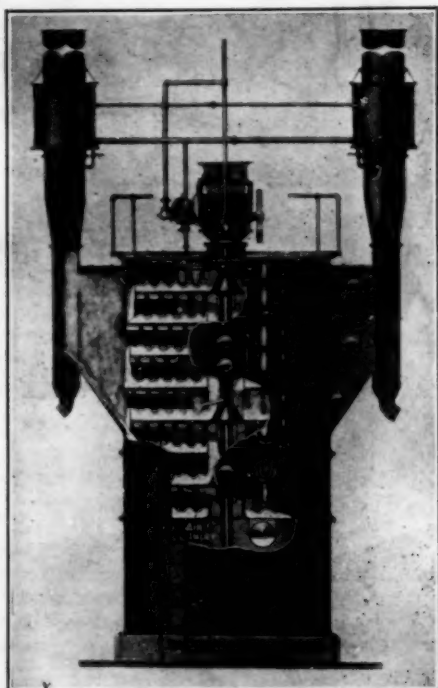
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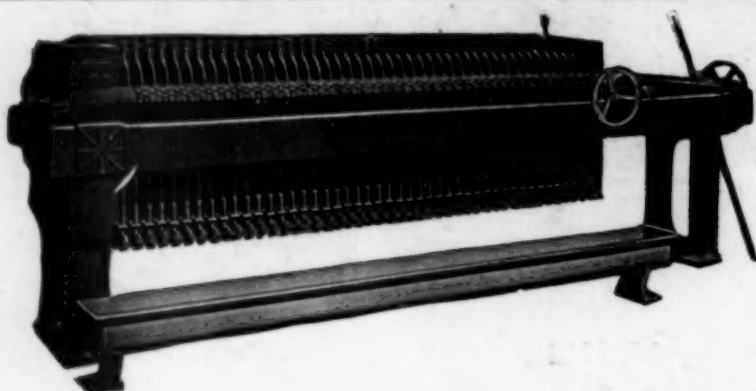
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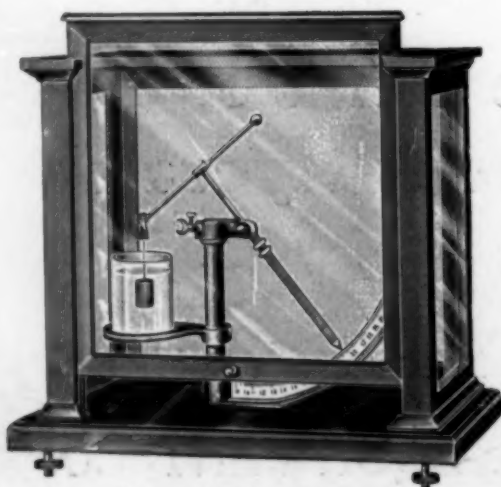
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Number 20

A New Trade Association of Chemical Equipment Manufacturers

IN THE organization last week of a trade association by manufacturers of chemical equipment, the chemical industry has now rounded out its quota of such associations. For some time past the producers of heavy and fine chemicals have been organized in the Manufacturing Chemists Association and the Synthetic Organic Chemical Manufacturers Association, and the makers of apparatus have been banded together in the Apparatus Makers Association. The group of four is now completed by the makers of plant equipment, who have just formed the Chemical Equipment Manufacturers Association. With every interest of the chemical industry thus organized, it should be possible through concerted action to accomplish whatever is best for its welfare.

The new association has been launched under most favorable auspices. Trade associations are the order of the day in business. Government encouragement and leadership are offered through the friendly attitude of Mr. HOOVER and the Department of Commerce, which has been reorganized to afford the greatest measure of assistance to business. That there are numerous problems internal to the chemical equipment manufacturing industry is clearly evidenced by the purposes and aims of the new association set forth in its constitution, printed elsewhere in this issue. And if any doubt existed in the minds of the organizers as to probable activities for the association it was dispelled at the first meeting when the subject was thrown open for discussion. Thoughts that apparently had long been slumbering in the minds of those present suddenly found expression in the form of suggested activities for the new organization.

We offer our congratulations to those manufacturers whose foresight has led them to create and foster the Chemical Equipment Manufacturers Association and we urge upon all others the merit of joining and supporting a movement that, in our judgment, must inevitably prove helpful to the industry. There are many problems of common interest to be solved, and doubtless many more will develop as experience is gained. Success in early undertakings will beget confidence in the organization and suggest new lines of activity. The movement has had sound guidance thus far and we confidently predict success if attention is directed primarily to the avowed purposes of the association. The first requisite is a membership representing as nearly as possible 100 per cent of the manufacturers of chemical equipment. The second is the selection of able and energetic officers and committeemen through whom the association will function. To those ends CHEM. & MET. is glad to lend its aid and encouragement and pledge its support.

New Lamps For Old

COMING when naval disarmament did, many fears were expressed that the abandonment of warship construction would prove the last straw to break the back of the deeply depressed metallurgical industry. With steel mills operating at one-quarter capacity or less and important brass works running but one or two shifts a week, to some pessimists it seemed particularly inopportune to shut off one substantial outlet for highly wrought metal and add to the millions of men facing a jobless winter.

However, a little calculation indicated that our warship program consumed an extremely small percentage of the total output of steel and alloys. With the exception of four or five sizable plants engaged in making armor and guns, it makes comparatively little difference to the industry by and large whether we are building warships or not. The proportion of their product going directly to the navy is small indeed—even armor plants are usually single departments of highly integrated steel companies, making almost everything from huge forgings to railroad spikes.

Sober second thought and a wide vision indicated immediately (and events have proved) that the indirect effects of naval disarmament were to be far greater than the direct effects. It is a truism that business is based on credit—that is to say trust—and nothing cuts deeper into the volume of sound trading than suspicion, wars and rumors of war. If naval disarmament increased the sum total of peace on earth by 1 per cent, the direct loss to those industries most vitally concerned has been repaid to them indirectly through their other departments. Other lines of activity have multiplied their profit enormously.

Being of an optimistic turn of mind, we are sure that even the dislocation and scattering of the personnel from the armor and gun plants will quickly redound to the benefit of sound metallurgy. Perhaps this is small comfort to the worker who must hunt up a new job and probably move to a new town, all at considerable loss in money and contentment. But there are few American metallurgical plants whose operations would not eventually profit by adding to their staff even one man who has been exercising for years that meticulous care necessary in the making of fine steels. Granted that the most of the laborers from gun plants are men who merely do as they are told without knowing why they do it, and therefore are not capable of applying their experience to other kinds of product, there are many other men, some with the advantage of college education and some who have acquired their knowledge in the works, men who have studied steel closely for years and have always made a sincere effort to find the cause of failures

in whatever stage of manufacture they occur, so as to avoid them in the future rather than to establish an alibi.

A wise manager does not let such men get away if he can possibly take care of them in any other department. But some managers are not particularly astute, and others may be chained by circumstances. So if one of these technologists of parts, metallurgist, heat treater, melter, smith, whatever he may call himself, is available, and you can obtain his services, do not hesitate to give him a job, for he will prove to be a jewel of great price.

Beginnings of

Chemistry in China

IN THE May number of the *Scientific Monthly*, Dr. WILLIAM HENRY ADOLPH gives some interesting notes on the history of chemistry in China. While the Chinese are responsible, he says, for many things long before the European world had developed them, "the tendency has been to consider the hoary annals of Chinese history a convenient dumping ground for disposing of clouded beginnings." We suggest as a secondary reason for the tendency that it is the safer guess. In the early sources of science there were three centers of almost independent development, of which India was the first, China the second and Egypt-Arabia-Europe the third and ours. The Hindus claim responsibility for being the teachers of China, but this is rather a claim than an established fact.

Like the development of chemistry in Europe, the Chinese began with an age of alchemy, which was followed by one of iatrochemistry, but the respective periods in China were much earlier than those of Europe. Alchemy was a Chinese art as early as 1100 B.C. Their iatrochemistry, or inorganic chemicomedical practice, which would more correctly describe it, began very early, but it lasted until the close of the nineteenth century. Two hundred years ago Chinese and Europeans were at about the same milestone of chemical science.

A number of interesting notes are given. For instance, mercuric chloride was used in surgery, although there is no evidence to indicate that the Chinese had any idea of the principle of sepsis. We understand that the people at large are still somewhat unfamiliar with the subject. Practice frequently outran theory, as with us, by many centuries. Gold, silver, copper, iron and tin constituted the "five metals," which were so known for a long time. Indeed the Chinese ideograph for a hardware store is literally translated "Five Metals Shop." Mercury was known as water-silver, and lead, being used only as an adulterant of tin, was not dignified as one of "the metals." This knowledge dates back to the early days of Chinese alchemy. The five metals were regarded as convertible into one another, a belief which grew from the fact that the galenites of China invariably contain all five, in varying proportions. There's a touch of philosophy in this conclusion which is especially interesting in the light of modern research. Discussion of "elements" and "original substance" date back to LOADZE, the great philosopher who flourished about 700 A.D.

Another theory with the odor of prophecy makes all compounds reducible to a single substance which is a gas. The gas may recombine with itself, and assume various forms and groupings. These are secondary ele-

ments and one philosopher likens them to vortex rings. They are of two kinds, being either positive or negative in principle. Combination between a negative and a positive may take place, and all the simple, material substances are formed in this way. This theory was put into its final shape in China about the tenth century of our era. With the substitution of hydrogen and H ions and OH ions for various Chinese words used in the text, it comes pretty near to telling what we think we think about matter today.

Alloys were considered as combinations, and much attention was given to the preparation of bronzes. Zinc was compounded with lead and bears the name "secondary lead" in current language. They had a phlogiston theory long before the days of STAHL, and they needed it more than our chemists, because they had scarcely any reagents. Heat was the universal agent used by them in their transformations. White lead is made by what we call the Old Dutch process, but the Dutch got it from the still older Chinese. Sulphates were prepared by oxidation of sulphides; they had no sulphuric acid.

Fevers and Chills

In Steel

ABOUT 20 years ago a stock brokerage house got out a prospectus for some new steel venture, inviting the confidence of the public on the ground that the steel industry had lately got into a position of stability and was no longer an uncertain proposition. The steel trade poked some fun at the statement, holding that the industry had been rather a stable affair for years.

Now we can take a longer range view. Much more than 20 years ago the late JAMES M. SWANK had said in one of his annual reviews that the iron and steel industry appeared to be chronically subject to alternations of chill and fever. ANDREW CARNEGIE, who was a great admirer of SWANK, said "prince or pauper," but that expression rather grates on one's nerves these days. Developments of the past 20 months show that the demand upon the steel mills, which is a different thing from the actual ultimate consumption of steel and manufactures of steel, is more subject to chill and fever than was the case 20 years and more ago.

Demand upon the steel mills fluctuates more than does steel production. The steel mills do not stock steel to any extent, simply making it on order. When demand decreases production decreases, but sometimes demand increases more than production, because production reaches a physical limit. Even production, however, has shown unprecedented fluctuations in the past 20 months. In the first 9 months of 1920 the rate of steel ingot production averaged 42,000,000 tons a year. At the middle of the following July the rate was down to about 10,000,000 tons. Then the rate rose to 25,000,000 tons Nov. 1, dropping to less than 18,000,000 tons at the end of the year, while last month has now shown a rate of more than 36,000,000 tons.

The United States Steel Corporation's "unfilled tonnage," which is reported monthly, has shown wide fluctuations, and yet these fluctuations do not exhibit the full fluctuation in demand, for when demand is heavy the corporation is reserved about accepting obligations and does not enter all the tonnage it is offered. The corporation's unfilled tonnage (including unspecified contracts) stood at a high point of 11,118,-

468 tons July 31, 1920, and decreased to 4,141,069 tons at the end of last February, the low point for years. At the end of April it stood at 5,096,917 tons, making an increase of 956,848 tons in 2 months. The shipments during the 2 months were about 1,850,000 tons, so that the bookings were about 2,800,000 tons, a trifle more than the full capacity, which is now reckoned at 53,000 tons (in steel products for sale) per working day. The shipments were at about 65 per cent of capacity in March and 70 per cent in April. Production would have been heavier in the latter month but for the coal strike.

That actual requirements in steel have been increasing since last July is beyond question, but they have not increased either as buying or as production has increased. Last July the country was running largely on stocks of steel and stocks of manufactures of steel. Lately it has been replenishing stocks. Jobbers and manufacturing consumers seem to have but one settled policy, never to keep their stocks uniform, but always to be increasing or decreasing them.

The bituminous coal strike has undoubtedly had much influence in stimulating buyers of steel in the past few months, both when the strike was being talked about as a certainty and when it was an actuality. Strikes have played and still play an important part in steel market history.

Photography as a Tool of Industry

AMONG the familiar tools of science, there is probably none which finds more universal application than the art of photography. In the modern routine of business and industry, there is scarcely an individual who does not depend to some extent upon one of the myriad applications of photography. In fact, such an admirable tool has it become that we are apt to lose sight of the fact that photography is a science in itself, keeping pace with the development of industry through the efforts of its devotees, who are at once scientists and artists.

In order that photography may serve industry most efficiently and blaze the way for progress in the technology of the industries, technical photographers have felt the need of closer co-operation with one another and with the industries that they serve. This sentiment has crystallized in the formation of a new organization, the Technical Photographic and Microscopical Society, details of which are set forth on the news pages of this issue. It is with an appreciation of the importance of industrial photography that we welcome the new society and bespeak for it the co-operation of the chemical and metallurgical industries.

Within the past few years photography has been enlisted to an increased extent in the aid of technology. Industrial establishments are coming to consider the permanent photographic department an invaluable adjunct to the business instead of an added item of overhead, as was once the case. Industrial photography not only has come to stay, but its applications are bound to increase. Witness the field opened by the ultra-rapid cinematograph in motion study or in the study of detailed stresses in physical tests. Witness, too, the development of apparatus for photographing such minute but spectacular physical phenomena as the disintegration of an alpha particle or the pulsations of an alternating current. Metallography has long been

indispensable to metallurgical research and photomicrography and macrography are becoming equally important in the pulp and paper and textile industries, in the study of powder, dynamite and other explosives, for the comparison of raw materials in the manufacture of drugs and chemicals, for studying gelatine and other emulsions, for investigations of yeast cultures, bacteria and molds, in studying leather tanning processes, in the technology of rubber, paint and pigments.

A step to correlate the experience and problems of photography in these and other fields should be of mutual benefit to all concerned and should open new uses for an already invaluable aid to industry.

An Innovation in the Teaching of Chemistry

BEGINNING next September, at the College of the City of New York, where Prof. HERBERT R. MOODY succeeds the late Prof. CHARLES BASKERVILLE as director of the department of chemistry, an interesting experiment will be made in presenting the general inorganic course in chemistry. This was formerly given by Dr. BASKERVILLE himself. The innovation will consist in bringing in various members of the staff and occasionally someone from outside the faculty to expound phases of chemistry with which each one is especially familiar and which he has taught successfully. The entire course will be supervised by Professor MOODY, who will address himself more particularly to industrial development within the science and such other features as may call for exposition by him.

This is the series in which the lecture hall is twice filled to capacity for each lecture. The purposes of the experiment are obvious. The students will receive instruction from men who have been tried and approved as teachers of their several subjects. To knit together what is said into a consecutive whole will present its own difficulties, but we have abundant faith in Dr. MOODY's capacity to do so. It will also bring the leading members of the staff into contact with a large proportion of the student body, which is also desirable. And it will provide a certain stimulus—we may almost say a gentle competition—in the art of exposition, within the faculty.

City College, as it is popularly called, is *sui generis*. It is free to residents of New York. There are very few automobiles or other objects of luxury owned by its students. The courses are intensive, and the students themselves are a very live body of young men. Their attention is remarkably close; they fairly eat up what the lecturer says. It is indeed an unusual experience to appear before them. We shall follow with keen interest the results of the experiment, and, more particularly, its effect on the faculty.

Another innovation which is to be introduced in the fall term is a series of lectures on chemical economics, to be delivered at both the day and the night sessions by Prof. FREDERICK E. BREITHUT, who has returned to the faculty. With the exception of Dr. BERNHARD C. HESSE, it would be difficult to find any one so well equipped as Dr. BREITHUT to explain the sources, the wanderings and the utilization of materials. The advantage of this course to chemists, especially to those engaged in business or technological activities needs no comment, and we predict for Professor BREITHUT a lively attendance, especially at his evening lectures, from the enrollment of graduate chemists.

Readers' Views and Comments

Improved Technology on the Chilean Nitrate Pampa

To the Editor of *Chemical & Metallurgical Engineering*

SIR:—I was disappointed to read that Paul F. Holstein, an interview with whom appeared in your April 12 issue, although emphasizing the need for improvement in the working of the average nitrate oficina in Chile, failed to indicate, directly or indirectly, the direction that such improvement should take. Many chemical engineers interested in the treatment of Chilean caliche feel that his experience there during many years would add weight to constructive criticism. They would appreciate something more than casual comment on the obvious need for "better recovery, more efficient fuel utilization and improved mining methods."

I suggest that the high cost of extracting the raw material has been due primarily to the expense incurred by selective mining—(1) in hand picking the richer caliche to boost the grade and make possible profitable operations on a small scale, and (2) to avoid the inclusion of slime or borra. Recent developments on one of the most refractory deposits in Chile are tending to disprove the need for this. Large-scale operations are inevitable eventually.

Low recovery of nitrate during beneficiation has been due to the inefficiency of treatment by the Shanks system and a neglect to appreciate the fundamental principles of a logical method of dissolving the nitrate and displacing the nitrate liquor.

High expense in fuel consumption has been aggravated because of a neglect to realize the cheapness and efficiency of solar evaporation in a country where atmospheric conditions are ideal for the purpose.

San Francisco, Cal.

A. W. ALLEN.

To the Editor of *Chemical & Metallurgical Engineering*

SIR:—I think Mr. Allen is entirely correct in his comments on the causes of high cost of extraction of the caliche, low recovery in manufacture and poor fuel utilization. The industry, in my opinion, requires a complete reformation in methods from the extraction of the ore in the pampa to the shipping, every step being susceptible of improvement, some of them in a very great degree. The combined reductions in cost possibly would reduce the cost of nitrate at the plant in many instances by 40 per cent and the cost f.o.b. by several shillings. The past 10 years has seen much, on the whole, unprofitable experimentation with new processes, most of them attempts to apply bits of knowledge snatched from milling practice without any great understanding of the applicability of the methods. The use of filters of various types is an example of one of these unfortunate efforts. While the nitrate man has gained costly knowledge, his enthusiasm has become much dampened as each much-heralded "invention" went the way of its predecessors into the scrap pile. The only definite advance made in many years outside of a better application and control of the old system has been the Allen process, which gets down

to fundamentals which, as very usual, means simplification. Filters, screenings, classification, etc., are in this industry, but medicine for the symptoms instead of for the disease itself.

Specifically I would indicate the following points (among many others) as worthy of study:

1. Co-operation of plants not too widely separated for the centralization of manufacture. The production of a cold solution and its transportation by pipe line to a central plant is not only feasible but has many more or less obvious distinct advantages.

2. The Shanks system has outlived its usefulness mainly through lack of appreciation of the fact that decrease in the percentage of nitrate in the ore being handled is accompanied by an increase in the percentage of insoluble matter and a consequently much greater proportionate retention of liquid by the extracted masses. Indeed old tailing dumps of 15 to 20 per cent nitrate content often indicate a higher percentage recovery of nitrate in those days than a 5 per cent tailings dump does today. The only reason that recovery today is as good as in the early years of the industry must be because of slower operation in leaching. This thought can be carried to its logical conclusion. If it were practicable, a plant consisting of, say, one hundred leaching tanks (cachuchos) and treating ten tank charges (fondadas) per day would give a recovery well over 90 per cent. This has been proved by the writer by experiments on slow operation on full-sized tank charges. It appears therefore that the time factor is a good point for attack, there being several ways by which this factor may be applied in a practical manner. As for leaching in a shorter time with a high recovery, particularly from ores containing much borra, there has been no method tried which appreciates the fundamental principles with the exception of the Allen process.

3. Evaporation of water from leaching tanks is a crime against common sense. As high as 50 per cent of the fuel consumed in some plants is thus driving off water from open boiling tanks. The non-technical manager often appreciates this to the extent only of stopping boiling, and then talks much about saving fuel but very little about recovery. Without entering into the other aspects of the subject, a triple effect evaporator will save one-third of the total fuel.

4. Hand picking of the ore in the pampa is not the only, though the principal, cause of high cost of ore placed at the plant. Several other factors might be mentioned, for instance car-loading, track-shifting, transportation. A penny per quintal here and a penny there is part of the 40 per cent possible reduction in cost previously mentioned. Should the ore be transported, or only the solution transported, to a central plant?

5. Regarding solar evaporation, it may be of interest that experiments conducted by the writer show that a ton of water is evaporated from nitrate solutions from an open exposed area of 3,400 to 3,600 sq.ft. The applicability of this fact has not been sufficiently ap-

preciated, yet it must not be immediately assumed that here is a solution of this point for all conditions; there are other considerations.

I think the most serious need of the industry today is a reconsideration of every step from ore in pampa to sales, without regard to precedent as established by methods outlived, but rejecting, changing and retaining solely by the criterions of simplicity, practicability and accordance with the fundamental facts. Indeed, many changes suggested years ago never really got much beyond conversation, principally because of lack of appreciation of the changing conditions and perhaps, too, of a lack of incentive by competition. Is it not conceivable that, if private producers do not make improvements, it may some day become the business of the Chilean Government, in self-preservation, to step in?

At a later date the writer hopes to go more fully into the above-enumerated and many other points, and though perhaps far from unbiased because of his convictions as to the best means for producing cheaper nitrate, it is believed at least that discussion and criticism will bring out many ideas and eventually establish truths that will serve as a basis for progress.

PAUL FERGUSON HOLSTEIN.

Buffalo Foundry & Machine Co.,
Buffalo, N. Y.
(Sailed for Chile, May 17.)

Mr. Almqvist's Point of View Repudiated

To the Editor of Chemical & Metallurgical Engineering

SIR:—The viewpoint of Harold Almqvist, of Domnarfvet, Sweden, as represented in his letter to you published in your April 5 issue, certainly does not represent, fortunately, the prevailing viewpoint in Sweden.

The majority of the people of Sweden during the war were of the Liberal and Socialistic parties and at no time were pro-German and at no time did they take the point of view your contributor has taken in regard to the European war.

The tone of the letter is unfortunate and the few Swedes to whom I have shown this letter have all expressed themselves as highly regretting Mr. Almqvist's contribution of provincial venom.

San Francisco, Cal.

J. W. BECKMAN.

Henry P. Davison—An Appreciation

To the Editor of Chemical & Metallurgical Engineering

SIR:—The name of the late Henry P. Davison, of J. P. Morgan & Co., who died on May 6, is doubtless familiar to most of your readers, although he was distinctly a banker, and as such he became eminent. He had the banking mind, with singular freedom from its faults. He did not think he knew what he did not know. He was, however, a person of such potentiality in affairs and of such remarkable strength that a note on his passing may not be amiss. He was one of the few financial leaders of this country. Our reserve banking system was largely of his making. Immense institutions of today are the children of his imagination and his great organizing ability. During the war his work to relieve suffering was probably unprecedented in the annals of history. And he was always constructive; he would not destroy for profit.

What manner of man was he? There was nothing unusual in his bringing up. His mother died while he was a young child, his father was of a roving disposition, and he grew up with a couple of elderly uncles who owned the village bank in Troy, Pa., where

he was born. They sent him to boarding school, but would not send him to college, which was a sore disappointment to him. Later he received no fewer than ten doctorates of law from leading universities and the grade of Major-General from the U. S. War Department. He taught school, became a bank clerk in Bridgeport, Conn., then in the Astor Place Bank in New York, and within a few years he was president of the Liberty Bank at the age of 31.

But how did he do it? We can give only incidental facts about him. He had a very engaging quality of good fellowship. Few men are loved as he was by those who were close to him. He was the best kind of company, with a rich sense of humor, although serious things were not funny to him. He did not worry about his dignity; that took care of itself. He was just a little quicker on the trigger than most other men; a little keener to sense what was going on. When he was a bank teller and a lunatic presented a check for a thousand dollars drawn to the order of Almighty God together with the end of a loaded revolver, he engaged him in such pleasant conversation about the size of the bills he wanted and meeting his convenience in every respect that the lunatic forgot to shoot until he was pinioned from behind. He thought only a little harder, a little more intensely, than other men.

He was not a speculator, and yet, when he knew he was right, there seemed no limit to his courage or his nerve. He recognized talent when he saw it, and thus surrounded himself with men of signal ability. He paid a little above rather than a little less than the market rate for services rendered. But he had also the catalytic quality that develops ability in others which theretofore lay dormant. There was no trickery in this; it was merely a little extra gift of what we call intelligence. Had he been selected as president of Yale, for which post his name was earnestly considered, and had accepted the task and retained his health, he would have been a rare inspiration to the students.

There was no particular quality that stood out as explaining his success in everything except perhaps his likableness and his resolution. At the age of 19 he wanted a post in the First National Bank of New York, but was frightened away by the man at the door. Fourteen years later he entered it as first vice-president. While at Bridgeport a post as cashier of a suburban bank with better pay was offered him, but he refused because he did not want "to get lost in a hole." When he applied for the position of paying teller in the Astor Place Bank he was refused. Three times he visited the vice-president, urging his suit, and the third time he won it. Then the vice-president telegraphed him that strong pressure was brought to bear to give the place to another, and would he accept a junior position at less pay? He replied that he would gladly do so. Three months later he was paying teller. This shows a little longer vision and a little more clearly defined purpose than most young men possess. His other qualities all seemed just a shade or so more developed than those same qualities in other men who are good and competent without being national figures or even great.

What a grand thing it would be for chemistry to add minds and characters of that sort to the practice of the profession! I do not deny that we have them, but we need more of them.

ELLWOOD HENDRICK.

New York City.

Thermal Problems of Petroleum Refining

To the Editor of Chemical & Metallurgical Engineering

SIR:—In your April 26, 1922, issue an article appeared by L. A. Mekler entitled "Thermal Problems of Petroleum Refining." On page 775 equations for coefficients of heat transfer a and b were given.

While probably Mr. Mekler did not intend to give the impression that the coefficients a and b respectively would hold for any cold or hot fluid flowing through a pipe, the casual reader might infer that the expressions given for a and b were general equations. The facts are that the value given for a represents certain data for water flowing inside pipes over a definite range of velocity and temperature, and similarly b represents certain data for air.

As a result of more recent investigations, equations more accurate than those quoted by Mr. Mekler are available for the flow of both gases and liquids in pipes.

As shown in recent articles, the general equations for the heat transfer coefficient between a fluid and the pipe through which it is flowing are quite complex because of their generality and must include corrections for the physical properties of the fluid being handled, such as viscosity, etc. In designing an oil to oil or a vapor to oil heat exchanger or preheater, the use of the coefficients quoted by Mr. Mekler may introduce enormous error; in the case of a direct-fired oil preheater or still, suitable allowance should be made for the transfer of heat by radiation, in addition to that transferred by conduction and convection.

W. H. MCADAMS.

Assistant Professor of Chemical Engineering,
Massachusetts Institute of Technology,
Cambridge, Mass.

Austrian Chemical Industries

FROM OUR SPECIAL CORRESPONDENT

VIENNA, March 22, 1922.

WITH the collapse of the Austro-Hungarian monarchy the new Austria has become a country with a rather weak and undeveloped chemical industry. Entire branches of its former industry have disappeared, not only because the works were located in the territory of some of the new succeeding states, such as Czechoslovakia, but also because raw material is not at all available or is present in insufficient quantities within the Austrian borders. Such, for instance, is the case with both the mineral-oil and the beet-sugar industries. Attempts have been made to increase the growth of beets in Austria, but so far only very modest progress can be reported. The harvest of 1921, because of unusually unfavorable climatic conditions, did not even reach the quantity produced in 1920.

CHINA AND GLASS INDUSTRY

A new deposit of kaolin has recently been discovered in upper Austria and there has resulted a considerable expansion of the ceramic industry. A new chinaware factory will soon be erected near Wels. A factory for the manufacture of plate glass, established in 1920, is working at Attnang (upper Austria), but up to the present time has been able to furnish only a small part of the plate glass needed in Austria. The purpose of these efforts is, of course, to render Austria as far as possible independent of Czechoslovakia, where nearly all of the glass factories of the former monarchy had been concentrated. It is also reported that another

company, founded in 1921, has taken up the manufacture of glassware in Stockerau, near Vienna.

PHARMACEUTICAL CHEMICALS

Industrial activity along pharmaceutical lines has had an unusual development since the breakdown of the monarchy. Existing establishments have been enlarged and a goodly number of new plants have been erected, some of which, to be sure, are still in the early stages of production. A factory producing salicylic acid in Kufstein, belonging to the firm Suchy-Werke, has already taken up work and the same firm is also manufacturing ichthyol products from a fossiliferous oil obtained from a seam of oil shale lately discovered in Tirol.

INORGANIC CHEMICAL INDUSTRY

The production of sulphuric acid during the war had been increased to a considerable extent. The annual productive capacity at the end of the war is compared with that of 1913 in the following table:

	1913		End of War	
	Sulphuric Acid, 92 to 98 Per Cent, Tons	Oleum, 20 Per Cent, Tons	Sulphuric Acid 92 to 98 Per Cent, Tons	Oleum, 20 Per Cent, Tons
Austria.....	60,000	3,900	80,400	62,700
Hungary.....	16,800	800	61,200	27,700
Total.....	77,500	4,700	141,600	90,400

The actual consumption during 1921 amounted to 53,000 tons of domestic production and 22,000 tons of acid imported from Germany, making a total of 75,000 tons. The total productive capacity after the war calculated in terms of 92 per cent sulphuric acid amounted to 236,000 tons, or something like three times pre-war requirements. The breakdown of the monarchy, however, has left Austria with only two oleum factories and one other important establishment producing other strengths of sulphuric acid. The production of pyrites had also been increased to 25,000 tons a month during the war, principally by more intensive operations of existing works and the resumption of production at various abandoned mines. In the new Austria pyrites is now mined at only a few places and in relatively small quantities, so that there is practically no domestic raw material for manufacturing sulphuric acid. Recently, however, it has been announced that the newly organized Permanganat-Aktiengesellschaft of Linz, which since 1921 has been producing potassium permanganate by an electrochemical process, is going to erect a new factory for sulphuric acid production. The same company is also erecting some new plants for wood distillation, since there is an entire absence of such an industry at the present time in Austria proper.

The situation as far as the manufacture of caustic soda is concerned is much more favorable. Austria has, it is true, lost nearly all of the establishments for the manufacture of this article, but the raw material is available in abundance from the brine of the Salzkammergut. Consequently the industry is preparing to manufacture caustic soda on a large scale. The Bosnische Elektrizitäts-Gesellschaft has enlarged its plant at Klagenfurt until it now has several times its former capacity. A new company, Elektro-chemische Werke of Aussee, is erecting a hydro-electric plant which will produce caustic soda electrolytically. The previously mentioned permanganate company at Linz also intends to produce caustic soda from brine in this manner. The utilization of considerable quantities of

chlorine, however, presents a very difficult problem. Only a small quantity can be used for manufacturing bleaching powder. It is hoped that there will be a commercial development for using chlorine in chlorinating methane, since natural gas is available at Wels, which is very near the salt mines. The opinion as to the quantity of gas to be obtained from these sources is, however, widely different.

The works of the former state gunpowder factory at Blumau, which during the war had been enlarged to enormous dimensions, have already been transformed and adapted for peace-time production. Their newly organized chemical company produces nitric acid, hydrochloric acid, sodium sulphate, and in addition a number of organic chemical products. Furthermore a fertilizer factory has been installed there and the melinite factory of Blumau has been altered and adapted for the manufacture of coal-tar products, such, for example, as aniline and certain basic colors. Only the oleum plant was not changed. A second large gunpowder factory had been built during the war by the Skodawerke-Wetzler Aktiengesellschaft near Tulln, but these works, with a power plant of 9,000 hp., and an estimated capacity for producing 400 tons of gunpowder per month, have not yet engaged in any extensive peace-time pursuits. An exception, however, is in the case of copper sulphate and chrome alum, now being made there.

Italian Chemical Industries

FROM OUR SPECIAL CORRESPONDENT

GENOA, Italy, April 6, 1922.

DURING the past 5 weeks there has been some recovery in the status of the Italian chemical industries. One reason has been the larger supply of electric current available due to an increase in the utilization of water power; another has been a further reduction in the price of coal and of certain imported raw materials. A general strike in all of the Italian ports recently brought imports and exports practically down to zero, crowding the harbors with ships loaded with all kinds of merchandise. In the port of Genoa alone there were at the end of March as many as twenty-seven ships loaded with coal awaiting discharge, and many others have since arrived. The industries that suffered most through this situation were the fertilizer manufacturers, the sulphur-mining industry and the metallurgical industry.

FERTILIZERS

After a series of discussions between the owners of the principal Italian fertilizer plants and their workers, an agreement has finally been reached which will keep alive the wage contracts effected last November. There are other factors, however, which are seriously affecting this industry. The situation in the phosphate market has completely changed owing to the continued fluctuations in foreign exchange and the increase in the cost of transporting phosphate rock from the mines to the sea in the principal countries of origin. During 1921 conditions in the phosphate industry were practically normal. The output of superphosphate was 501,975 tons, as compared with 496,575 tons in 1920. The maximum productive capacity of Italian plants for producing superphosphate is probably in the neighborhood of 750,000 tons. Consumption in Italy during 1921 was about 850,000 tons, although in 1913 it had reached 1,070,000 tons.

During the war practically all of the supplies of

nitrate of soda were used for the production of explosives. Sulphate of ammonia, produced as a byproduct in the manufacture of illuminating gas, was produced in a quantity corresponding to only about one-half of the pre-war output. Likewise the importation was enormously reduced. During 1913 there was a consumption of about 100,000 tons of nitrogenous fertilizer; in 1918 this had fallen to 50,000 tons and in 1919 it remained at approximately this amount. Some little increase was noted in 1920, and there was further betterment in 1921. During this latter year the consumption of nitrate of soda was 32,000 tons, against an average of 55,000 tons before the war; that of sulphate of ammonia was 20,000 tons (of which only about one-half is of domestic origin), against an average consumption of 35,000 tons in 1913. The consumption of ammonium nitrate was about 12,500 tons, that of cyanamide was 16,000 tons in 1921 and 24,000 tons in 1920. Italy consumed only about 8,000 tons of crude potash salts during 1920, as compared with 28,000 prior to the war. The average consumption of potash in Italy at that time was 0.8 of a kilo per hectare of cultivated ground, while in France the average was 3.2 kilos, in Belgium 20 kilos and in Germany 63 kilos.

SULPHUR AND BLUE VITRIOL

A meeting was held in Rome about the middle of last month for the purpose of demanding the immediate intervention of the government in settling the crisis existing in the Sicilian sulphur industry. It has since been reported that a large Italian bank would offer financial backing to one of the most important mines, and it is hoped that this will result in speedy recovery and consequent re-employment of the miners.

The sulphur refineries of Cesena, Bellisio and Pesaro have been working regularly with satisfactory results and continue to produce products of good quality which find sale in Italy and abroad. The refinery of Murano was closed and its work taken up by the refineries at Bagnoli, Borgo Panigale, Pozzolo, Reggio and Rifredi. The Societa Unione Raffinerie Siciliane, as a consequence of the high prices arranged by the sulphur consortium for its raw material, has had to reduce its activity considerably.

The consumption of copper sulphate was unusually good in 1921 and the establishments at Vicenza, Casale, Rifredi and Bagnoli were able to take care of a considerable part of the supply. A new plant is under construction at Reggio Emilia and it is believed that a plant in this locality will facilitate the distribution of the product and also reduce expenses of transportation. Blue vitriol will also be produced in the works at Piano d'Orte and in other chemical plants of that vicinity. The total production of copper sulphate at present is about 1,000,000 tons per year, whereas the national requirements are probably only about 750,000 tons.

PHARMACEUTICAL PRODUCTS

On March 4 the special committee which is assisting the Ministry of War in the sale of those pharmaceutical chemicals obtained from Germany on account of war reparations established a sales organization for these products with the Farmacia Centrale Militare of Turin. Certain limitations have been set on these sales with a view to protecting the interests of the Italian industry producing pharmaceutical products. It is reported that the German goods are in very good condition and nearly all are in the original package bearing the name of the original producer.

The Business Side of Chemical Manufacturing

In This Article, the Second in the Series, the Marketing Function Is Analyzed, the Necessary Steps Are Outlined and a Detailed Consideration of the Advertising Department Is Undertaken

By CHARLES WADSWORTH, 3D

THE marketing function in any organization includes a number of departments. The scope of these departments varies tremendously with the type of organization and with the men in it. If, for example, we were to describe accurately the functions of the sales department in a given organization today and if tomorrow a new sales manager were appointed, we would have to rewrite our description. The old description would not fit the new department. Let us take a mythical example. Old J. P. Smith, head of the sales department, had been with the company 30 years. He was a Tartar and people never intentionally aroused J. P.'s wrath. Fulton, head of advertising, was the only one who dared to argue with him, but "J. P." had the final say on all marketing policy. "J. P." died, and Sprague, metropolitan district sales manager, took over the work, but Fulton dominated sales policy from that time on. So you see we would first have said the advertising manager formulated all the plans for campaigns, but they were always revised and approved by the sales manager. After "J. P.'s" death we would have to say the advertising manager had entire charge of the planning of the marketing campaigns and the co-operation of the sales department was tacitly assumed. With the possibility of such variations in mind, let us examine the various component departments co-operating in the marketing function of an organization. The following steps are undertaken in the order named and the work is accomplished by the department or group listed on the same line.

- | | |
|--------------------------------|---------------------------------|
| 1. Locate the market. | Sales research or engineering. |
| 2. Interest it in the product. | Advertising. |
| 3. Classify prospects. | Credit. |
| 4. Consummate sales. | Sales. |
| 5. Deliver the product. | Traffic. |
| 6. Keep customer satisfied. | Trouble dept., or sales source. |
| 7. Collect the bills. | Collection (or credit). |

There are a great many more incidental steps necessary which will be taken up under the detailed consideration of the departments, but those steps just mentioned summarize the functions of the main departments engaged in this work.

Advertising

In the first article of this series I mentioned only two of these departments as being fundamental units of organization, sales and advertising. That was because the other departments are usually subsidiary functions of the sales department. Not infrequently sales and advertising will also be under one head, but they are more apt to keep their own identity, and therefore deserve to be considered fundamental units. In discussing this work we shall adhere to our original classifica-

tion and take up advertising first and then all the rest of the functions under sales.

In this discussion of advertising we are forced to leave the chemical field for our models. The question, How shall advertising be done? cannot be answered by the chemical industry. With the exception of perhaps half a dozen large corporations chemical advertising is rather unintelligent. It is unintelligent because it is generally not well advised. Good advertising men are not used.

There is rather a valid excuse for this, however. It is this. Advertising technique seems at first glance to be simple. As a very able advertising man once remarked, "Every American business man believes that he is pre-eminently competent to criticize advertising copy and organize an advertising campaign, whereas nothing could be farther from the truth." The result is that at first business men are very apt to underestimate the value of an advertising department. The first industries to appreciate its value have been those selling to the general public. Their advertising departments have been able to show conclusive proof of more efficient expenditure and greater net results. The chemical industry does not sell to the general public and has been slower, therefore, to understand the value of advertising and of the advertising department.

RELATION TO SALES DEPARTMENT

If you will recall the definition given of the advertising function, it was "to interest the prospective customer in the product." It is the second step in marketing the product and must very obviously be closely co-ordinated with other marketing effort. Co-operation is really not a strong enough word to indicate the relationship which should exist between advertising and sales. United is more accurately descriptive if we remember that this should not mean a complete merger of identity. The advertising manager must be intimately familiar with all of the other steps of marketing. He is the only one who needs to be in this position. All of the other marketing units such as sales engineering, credit, traffic, etc., function fairly independently. Not so with advertising. The manager must study the sales engineering or research work, the demand for the goods, the distribution of the market, competition, merchandising methods, policy of price regulation. These things he must correlate with the details of advertising policy. He therefore acts as a consultant in the marketing field. By the very requirements of his work he is in a position to get a perspective of marketing which is unique.

The work of the advertising department falls naturally into three parts: 1. Planning. 2. Production. 3. Statistical.

For this discussion we shall devote most of our time

The first article in this series appeared in CHEM. & MET., vol. 26, No. 15, p. 679, April 12, 1922.

to planning. The technique of producing advertisements is too complicated for treatment in an article of this kind. There are many excellent books which take up this subject, and none of them contains less than several hundred pages. It would be impossible even to list and balance the factors which must be considered in constructing advertisements. Men who have such work in charge correspond to high-grade technical men in other departments. They have artists, draughtsmen, copy writers, photographers to assist them. In a large department such men are called creative men. They must be capable of translating advertising policy into a message through one of the many methods of advertising. The production unit of the advertising department will vary in size as greatly as the production unit in a plant: from zero on the one hand where the department depends on the agency or the publishing house for practically everything, to units which in addition to large staff of specialists will have their own engraving done and send the finished plates to periodicals. The needs and temperament of the business will determine the kind of production unit.

Similarly the statistical work of the advertising department may be negligible, with scarcely an adequate record of the kind of advertising placed. Or it may be of the most elaborate kind, including tables of sales or other returns classified by the medium used, the time of year or month, the territory, the salesman and in combinations of these classifications. Then there can be costs per unit sold or per unit advertising depending on the judgment of the head of the department and the kind of results desired.

PLANNING

We are mainly interested, however, in the planning. It is here that the advertising manager displays his deftness in co-ordinating advertising effort and sales policy. It is the most important part of the advertising manager's work. Good drawing, good copy, good layouts, good choice of medium, all go for naught unless they are part of a plan harmonious with sales effort. Examples without number indicate the loss which results from a petty jealousy or lack of co-operation between sales and advertising.

Therefore before making any plans the advertising manager should absorb (and perhaps modify or create) marketing policy. With that as a foundation he can begin to build toward a definite result. Advertising should strive for a definite result almost quantitatively expressed.

Naturally the size of the appropriation is closely tied to the results desired. You can't buy a Rolls-Royce when you can only afford a bicycle. Neither can you reach the ten million people, nor ten industries, nor the automobile accessory men in ten states when you can afford only one of each. So we have two factors to determine first, the result desired and the appropriation. Usually the board of directors determines the appropriation and the advertising department does its best with what it can get. The department, however, should be able to supply the board with programs of what can be accomplished with various given amounts.

DISTRIBUTION OF ADVERTISING

Given an aim and an appropriation, the most difficult problem is that of distribution.

Shall we use direct advertising, periodical advertising or poster advertising?

Those are the three classes of advertising which are

usually differentiated. Direct advertising may not be an obvious term. It includes all forms of advertising which are specifically addressed to an individual. Usually this takes the form of mailing circulars, catalogs, letters or advertisements.

By far the largest annual expenditure for advertising is for periodical advertising, including newspapers, magazines, programs, etc. This does not mean that periodical advertising is the best kind of advertising. There is no "best kind" in general. Practically all of the Sears-Roebuck appropriation goes into direct advertising, whereas for years Campbell's soups appeared only on posters and car cards. Each advertiser has a different problem, a different group of prospective customers, a different appeal, and consequently would choose different media. It is obvious that the problem of distributing advertising is one which should command experience and knowledge of advertising technique. On what basis except experience can there be any preference for one method as against another? The only other basis is the royal game of guess, in which the ordinarily shrewd business man seems to like to indulge. It is incidentally a convenient way of accounting for poor advertising.

CHEMICAL ADVERTISING

It has seemed to me rather obvious that, in general, chemical advertising could be limited to direct advertising and advertising in technical and trade periodicals. With a definite and limited list of prospective consumers, manufacturers of chemicals and chemical equipment do not have the difficult problems of national advertising to face nor yet those of local advertising to the general public. (The few exceptions to this general rule, chemical manufacturers whose products go to the general public, are in a healthier condition in regard to advertising policy than the rest of the industry and will be neglected in this article.)

Evidence is at hand that there are advertisers who do not agree with the above thesis. A large manufacturer of equipment recently appeared in some full-page displays in the *Saturday Evening Post*. For the price of one page he could have covered his six biggest consuming industries for a year in the technical and trade magazines. That is one example of unintelligent advertising.

Again, a manufacturer of chemicals spent nearly a thousand dollars putting little 1/4-page announcement cards in trade periodicals and did not back up the campaign with proper sales support. He received three inquiries—from dealers—in the course of a year. He was depending on his advertising to make sales, an ill-conceived policy, expensive no matter how few dollars and cents are involved.

These two advertisers represent the two extremes—the profligate spending of a large and poorly estimated appropriation on the one hand and the self-advised throwing away of a small amount of money on the other. Most chemical advertising resembles the second example. The attitude of the advertiser lies midway between that of a patron of art bountifully bestowing a largess and that of a skeptic who, though he does not believe in vaccination, nevertheless for his own peace of mind grudgingly pays a physician to be inoculated. The idea that advertising is an aid to marketing and is a study conducted by experts on scientific principles has not seemed to occur to the chemical advertiser.

The point I am anxious to make is this: Chemical

manufacturers must realize that their advertising problems should be solved with the aid of the advertising experts. Otherwise their money is apt to be wasted.

INDIRECT ADVERTISING

There are other methods of advertising—indirect methods. They have value, although they are not usually included in advertising appropriations. Manufacturers of high-grade automobiles sometimes make it a practice to keep cars of their make looking well. When they see a dilapidated car they approach the owner with offers to trade it in or have it fixed up. An analogous procedure exists in the follow-up of some firms to make sure their customers are satisfied.

One enlightened firm sends some of its technical representatives to the various conventions at which consumers of its products are likely to be found. No soliciting is done, but the good appearance and friendliness of these men create a very favorable tone.

The trouble work, so called, or sales service, which will be discussed later, is a splendid advertising aid. One satisfied customer is worth a number of prospects; the exact number depends on the product and might vary from two or three with acids to say fifty with dyestuffs.

Every point of contact with other firms presents an opportunity to create favorable or unfavorable impressions and to build up assets and liabilities. The policy of collecting accounts may lose friends. The purchasing agent may leave a bad impression on salesmen. The company's salesmen in particular are ambassadors reflecting policy. All of these contacts are indirect advertisements and should come under the scrutiny of the advertising manager.

THE ADVERTISING AGENCY

If I had been made advertising manager of a company I should certainly not begin to talk about advertising agencies at once. It would be poor psychology. Presumably the board of directors would assume that I was trying to get someone to do my work for me. Few persons realize that the advertising department and the advertising agency are complementary and not interchangeable. The point at which the department stops and the agency begins varies with each company. One firm may have an advertising manager and two or three stenographers or clerks who simply keep records. In such a case the agency would co-operate in planning the campaign, produce all the drawings and literature necessary, take charge of accounting, etc. The same agency may have a client with a large staff of advertising men, artists, compositors, as well as routine clerks, etc. In such a case the agency acts in an advisory capacity only.

In any national advertising the advantages of dealing with an agency are very great. Its wealth of experience can be focussed on the problem of the individual firm to great advantage. It cannot displace the advertising department, however. Experience has shown that it is very wise to have the point of view of someone inside the organization turned on these problems. Several large companies have experimented with this plan and abandoned it.

There is less evidence of the value of the agency in technical advertising. There has been less of it for them to do and in addition many accounts were and are still unwisely undertaken by agencies—accounts about which they know very little. Their advice is therefore either superficial or obtained from technical publishers. So widespread has this been that a large number of

technical publishers have instituted their own advertising service. Some have all the facilities of first-class agencies at their disposal and are able to plan for clients a campaign of advertising which will put their product before that part of the technical world which will be interested.

In general then the agency has yet to prove its value in technical advertising, but has won a deserved place in the counsels of national advertisers.

There have been no figures given here to show the value of advertising. That has not been the purpose of the discussion. Such figures are easily available, even in our backward industry. A firm which tries to market without obtaining the advice of an advertising expert and finding out whether and how he should advertise is like the man who lit a candle and put it under a bushel basket. It is a waste of light. Rather set it on a candlestick and use the lenses and reflectors of advertising so that the light will go where it will do most good.

A word of caution to technical men may be in order. Our confessed attitude in these articles has been how valuable technical training is in non-technical departments. In the case of advertising, however, technical men will find their training of least value. It would be difficult to justify a technical course as a preparation for advertising. Other things would be so much more worth while. Every position, technical or non-technical, should be approached with humility but with perhaps confidence. If you are drawn toward advertising, take it up with more humility and less confidence but with great optimism. The future is there for the department and for the man who creates and develops it.

Indications of a Finished Heat in Acid Electric Furnace*

BY JAMES L. CAWTHON, JR.

In the acid way, a percentage of silicon may be reduced from the slag. Under certain conditions, if the temperature is permitted to get high, the slag highly acid and the furnace condition highly reducing, a considerable amount of silicon will be reduced from the slag. The action which produces this takes place at a very rapid rate, conditions being propitious, and a closer analysis may be obtained if this condition be avoided, relying entirely upon a ferrosilicon addition.

All three of the conditions mentioned above are necessary to silicon reduction, and by modifying any one of them it can be stopped instantaneously. The simplest method is to introduce a small amount of fire-clay or lime immediately under the electrodes. To the operator experienced in acid electric furnace operation, the condition is immediately apparent by several signs, among them being the almost total silence of the arcs, the extreme paucity of fumes around the electrodes and the general "tightness" of the furnace.

It may be added here that this condition which comes about in the acid electric furnace is indicative of a highly deoxidized condition of the bath. Tests taken from heats under this furnace condition show the metal to be in excellent condition. Its use, with proper judgment and understanding, may therefore well be adopted. Some steel foundries regularly permit a heat to come to this condition incipiently before tapping, the results being reflected in the soundness of the castings.

*Extract from a paper on "Synthetic Cast Iron," read before the Baltimore meeting of the American Electrochemical Society, April 27, 1922.

Studies in the Carbonization of Coal: Characteristics of Low-Temperature Coal Tar*

Outline of a Scheme of Examination for Tars Obtained in the Low-Temperature Carbonization of Coal—
Composition of a Commercial Low-Temperature Tar and Comparison With Coke-Oven and
Gas-Works Tars—Review of Results Obtained by Previous Investigators

BY JEROME J. MORGAN AND ROLAND P. SOULE

Department of Chemical Engineering, Columbia University

THE present report is the first of a projected series of studies in the carbonization of coal. It concerns itself primarily with an examination of a low-temperature coal tar, but its scope has not been confined to specific analytical data. In the absence of any standard analytical procedure in this little explored field, it has become necessary to develop a scheme of examination by which the component groups of low-temperature tars may be readily examined. An intensive investigation has been made of a commercial low-temperature tar, comparing the analytical results obtained with those of other tars. This scheme and the character of the tar determined by it are described in the present paper.

The composition of this tar indicates a stage in the decomposition of the primary liquid distillates of coal which hitherto has not been carefully studied. In a second installment it is intended to define more precisely several distillation reactions, and to present a new viewpoint on the much disputed mechanism of the carboniza-

tion of coal. Thus, a rational basis will be found for reconciling to a large extent the reported differences in the composition of low-temperature coal tars.

Until recently the commercial carbonization of coal has been performed at 1,000 to 1,300 deg. C. primarily for the production of city gas and metallurgical coke. Within the past decade, however, lower temperatures of distillation have been made to serve two purposes. The first of these is scientific in nature—the study of the products of distillation at various temperatures has shed light on the constitution of coal, and afforded evidence for theories of carbonization. The second object has been the production of new materials of commercial value. By distilling an ordinary bituminous coal at 500 to 600 deg. C. there are obtained a friable, free-burning coke which may be made to serve as a smokeless fuel, and a distillate which upon removal of the phenols resembles crude petroleum in properties and uses.

OUTLINE OF INVESTIGATION

An outline of the type of methods used in the present investigation is given in Fig. 1. According to this pro-

*Condensed from a thesis presented by Roland P. Soule in partial fulfillment of the requirements for the degree of Doctor of Philosophy in the Faculty of Pure Science of Columbia University in the City of New York.

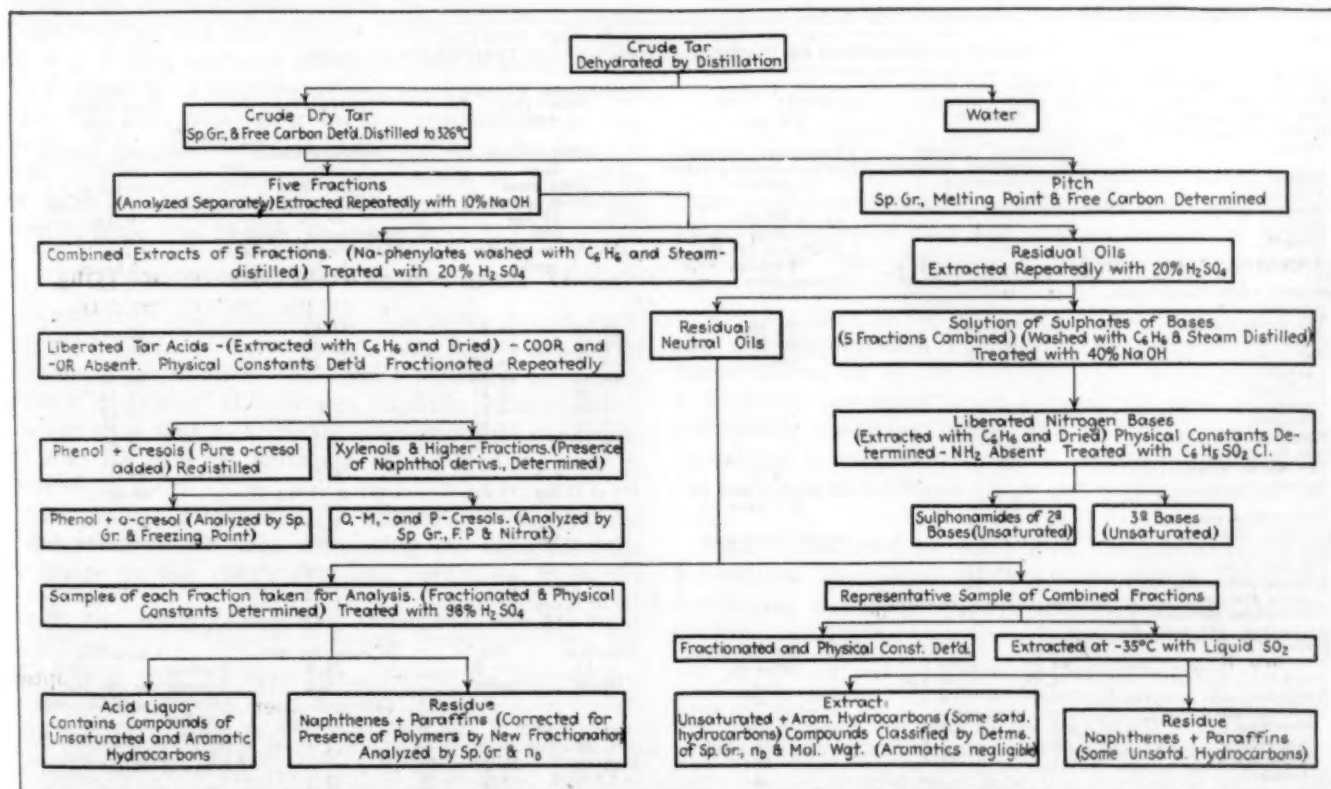


FIG. 1—SCHEME OF EXAMINATION OF A LOW-TEMPERATURE COAL TAR

TABLE I—SUMMARIZED COMPOSITION OF CARBOCOAL DISTILLATE

Component Classes	Basis of Distillate	Percentages by Weight Basis Crude, Dry Tar
Phenols.....	42.7	13.7
Nitrogen bases.....	1.94	0.624
Hydrocarbons a.....	55.4	17.8
Cyclic unsaturated.....	41.5	13.4
Saturated.....	13.9	4.4
Naphthene.....	8.8	2.8
Paraffine.....	5.1	1.6
Totals.....	100.0	32.1

a May contain traces of aromatic hydrocarbons.

cedure the tar examined was found to have the composition indicated in general by Table I and Fig. 2.

Fig. 2 shows the change in the percentages by weight

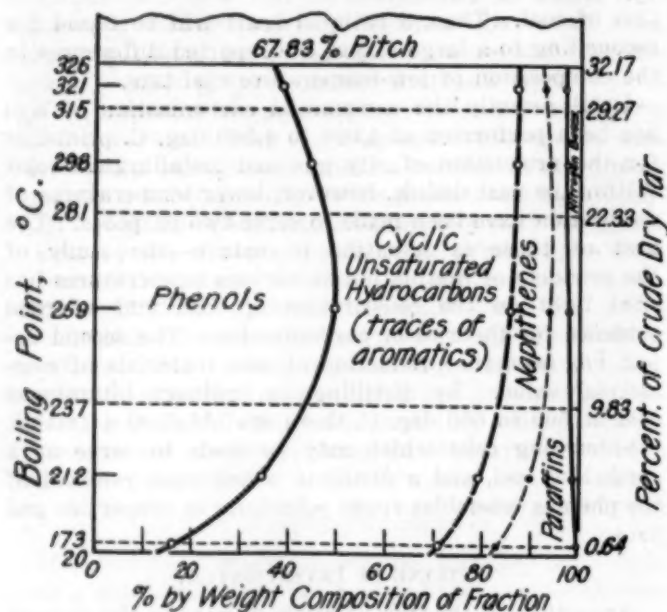


FIG. 2—COMPOSITION OF THE CARBOCOAL DISTILLATE

of the various classes of components in the condensate as the boiling point of the tar rises during distillation. The vertical axis of boiling temperatures is so graduated that the areas of the figure represent proportions by weight of the different groups. The horizontal dotted lines separate the five fractions of the distillate, and the curved lines are the boundaries between the component groups.

RÉSUMÉ OF EARLIER STUDIES

Low-temperature coal tar may best be defined as the tar produced by the carbonization of coal at temperatures (500 to 750 deg. C.) not high enough to cause an appreciable decomposition of the primary liquid products of distillation.

Certain circumstances must be borne in mind in attempting a comparison of previous investigations of low-temperature tars. The low heat conductivity of coal makes the exact nature of tars distilled at approximately the same temperature dependent upon such factors as agitation, rate of distillation, the thickness of the fuel layer and the resulting temperature gradient. Moreover, the extent to which secondary reactions may also occur is determined by the pressure employed, the use of steam, the size of the gas space, the temperature of the crown of the retort and other conditions controlling the path of the gases.

Of the several investigations of one aspect or another of low-temperature tars, four studies are cited in Table II as the most important and representative efforts toward a through analysis. A. Pictet¹ and his co-workers in Switzerland and D. T. Jones and R. V. Wheeler² in England employed the tar as an agent in their re-

¹A. Pictet et al., *Ann. Chim.*, [9], vol. 10, p. 249 (1918); cf. A. Pictet and M. Bouvier, *Ber.*, vol. 46, p. 3342 (1913); vol. 48, p. 926 (1915); *Compt. rend.*, vol. 157, pp. 779, 1436 (1913); vol. 160, p. 629 (1915); A. Pictet, O. Kaiser and A. Labouchere, *Compt. rend.*, vol. 165, pp. 113, 358 (1917).

²D. T. Jones and R. V. Wheeler, *J. Chem. Soc.*, vol. 105, p. 140 (1914).

TABLE II—COMPARISON OF INVESTIGATIONS OF LOW-TEMPERATURE TARS

Name of investigators.....	Morgan and Soule 1921—1922	A. Pictet 1913—1918	Jones and Wheeler 1914—1915	S. W. Parr 1914—1915	F. Fischer 1916—1919
Date of investigations.....	500—600	450 max.	430	450—525	350—500
Temp. of distn., deg. C.....					
Distillation apparatus:					
Form.....	horizontal cylinder with rotating screws	2 horizontal D-shaped retorts, one above other	round-bottom flask	vertical cylinder	horizontal rotating cylinder
Material.....	Carborundum	Cast-iron	Jena glass	Cast-iron	Cast-iron
Dimensions.....	18 ft. x 7 ft.		about 1 liter	44 in. x 6 in.	110 cm. x 30 cm.
Amount distilled.....	5,000 lb.	1,500 kg	1.25 kg	20 lb.	10 kg.
Method.....	Dry	Dry	Dry	Superheated Steam	Steam
Pressure.....	atm.	15—20 mm. of Hg	13—15 mm. of Hg	< 8 in. water above atm.	atm.
Time.....	3 hours	5 hours	5 weeks	6—8 hours	1—2 hours
Coal.....	Pa. "Pittsburgh Terminal"	Montrambert (Loire)	Scotch Durham	Illinois (Vermilion Co.)	Lohberg gas coa
Analysis (dry basis), in per cent:					
Vol. comb. matter.....	35.30	15—20	20.36	34.92	39
Fixed carbon.....	57.92	66—75	70.36	48.81	59
Ash.....	6.78	10—15	3.28	16.27	1.65
Carbon.....			86.92	86.88	80.68
Hydrogen.....			4.98	5.41	5.54
Oxygen.....			5.56	4.71	7.67
Nitrogen.....	1.65		1.75	1.75	1.90
Sulphur.....	1.77		0.79	1.25	0.67
Crude, dry tar					
Per cent by weight of coal	11.3	4.0	6.5	8.7	10
Specific gravity.....	1.0676 at 15.5 deg./15.5 deg. C.	< 1 fresh, 1 in 3 hr. > 1 later	0.999 at 15 deg./15 deg. C.	1.072 at 15 deg. C.	"about 1"
Free carbon, per cent.....	0.71			1.35	
Max. temp. distn. tar.....	326	steam distillation	300	400	superheated steam distn.
Pitch					
Per cent of tar.....	67.83		50	30	
Melting point, deg. C.....	53		"soft"	110	
Specific gravity.....	1.134 at 15.5 deg./15.5 deg. C.		1.128 at 15 deg./15 deg. C.	1.27	
Free carbon, per cent.....	2.17		0	12	
Composition of tar, in per cent.....					
Distillate		Crude, dry tar basis		Crude, dry tar	Crude Tar
Phenols.....	42.7	13.7	12—15	28.0	Phenols..... 50
Bases.....	1.94	0.624	traces	0.2	Non-viscous oils..... 15
Alcohols.....	0.0	0.0			Lubricating oils..... 10
Hydrocarbons					Paraffine..... 1
Paraffine.....	5.1	1.6			Resins..... 1
Naphthene.....	8.8	2.8	40	20	Pitch..... 6
Unsaturated.....	41.5	13.4	40—45	20—23	Loss and water..... 17
Aromatic.....			7	3.5	

a Eight per cent of phenols found by Pictet in a later analysis.

searches on the constitution of coal. S. W. Parr³ and his associates in this country were primarily interested in the commercial aspects of low-temperature carbonization, as were F. Fischer⁴ and his staff in the Kaiser-Wilhelm Institute of Coal Research in Mülheim-Ruhr, Germany. The details tabulated in the case of Fischer's work represent only one of a large number of related experiments, but serve to indicate his characteristic method of reporting tar investigations in technical rather than in scientific terms. For the purpose of comparison the results obtained in the present investigation are also included in this table.

ORIGIN OF THE TAR EXAMINED

The tar examined was produced by the "Carbocoal" process⁵ (C. H. Smith patents) of the International Coal Products Corporation. It was a representative sample made in March, 1921, under commercial conditions at the experimental plant of the company at Irvington, N. J.

The low-temperature tar produced by the primary retorts is the subject of this investigation. These retorts are horizontal, about 18 ft. long, and of cardioid section. The walls are constructed of carborundum blocks, and the ends of cast iron lined with firebrick. The coal is continuously stirred and advanced through the retort by paddles of radius 2 ft. 3 in. mounted on two parallel 12-in. paddle shafts, which revolve at 1.8 r.p.m. Each retort is operated about one-third full, and has sufficient capacity to permit an output of 1 ton an hour. The products of distillation leave at the top of the discharge end of the retort. The temperature in the retort shell is about 730 deg. C., in the gas at the feed end of the retort 300 deg. C. and at the discharge end about 500 deg. C. The temperature of the discharged coke approximates 480 deg. C.

It is apparent from this description of retort conditions that the opportunities for secondary decomposition are not negligible. Thus the outgoing products of distillation come into contact with surfaces heated to 600 deg. C. and undergo decomposition to some extent.

A Pennsylvania bituminous coal known as "Pittsburgh Terminal" coal was used in the preparation of the sample of tar examined. Its analysis⁶ on a dry basis is given in Table II. The moisture content of the coal as fed into the furnace amounted to 2 per cent. The calorific value was 13,925 B.t.u. per lb.

PROPERTIES OF THE TAR AND PITCH

Dehydration and Distillation. Carbocoal tar, in common with other low-temperature tars, is a black oil of petroleum-like fluidity. It smells strongly of cresols and to a less extent of hydrogen sulphide. The viscosity is lower than that of ordinary coke-oven and gas-works tar, and no odor of ammonia or naphthalene can be detected in it.

The tar was dehydrated for subsequent examination by distilling to 200 deg., separating the light oil from the water in the condensate and returning it to the

TABLE III—FRACTIONATIONS OF REPRESENTATIVE TARS¹⁰

Fraction B.P. Range Deg. C.	Percentages of Total Weight		
	Low-Temperature Tar	Coke-Oven Tar	Gas-Works Tar
20-173	0.64	0.70	1.19
173-237	9.19	8.27	9.22
237-281	12.50	12.44	10.12
281-315	6.94	6.21	3.78
315-326	2.90	2.53	1.93
Pitch (diff.)	67.83	69.85	73.76
M. P. of pitch, Deg. C.	53	69	89

main body of tar remaining in the still. A specially constructed 3-gal. copper tar-still of the same proportions as the Barrett type⁷ was used in the operation. About 8 kg. of tar was distilled at a time. The content of water in the sample of tar amounted to 2.12 per cent.

A sample of thoroughly mixed, crude, dry tar was taken for specific gravity (Hubbard bottle) and "free carbon" determinations according to standard procedures⁸. A dry distillation of the 8 kg. of crude tar thus dehydrated was made at atmospheric pressure in the same copper still. The rate was 15 c.c. per minute, or about 0.2 per cent of the total volume of tar per minute. For comparison samples of coke-oven tar⁹ and gas-works tar⁹ were fractionated in exactly the same manner and the results are recorded in Fig. 3 and Table III.

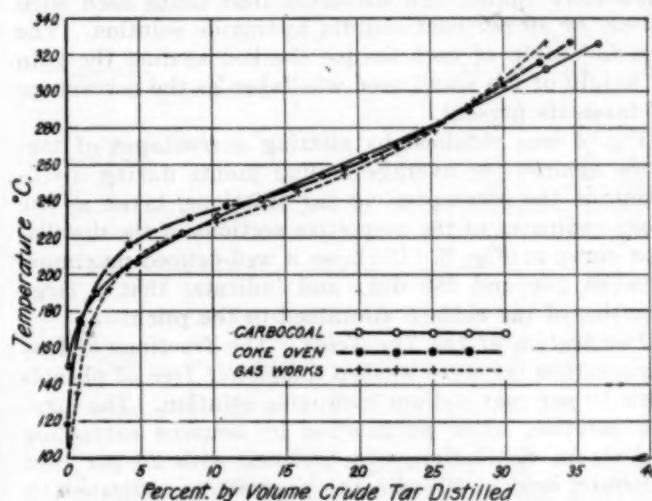


FIG. 3—DISTILLATION OF CRUDE, DRY TARS

In general there is a close resemblance between the three fractionation curves, disproving the many exaggerated statements that have been made of the larger quantity of low-volatile oils in low-temperature coal tars. The percentage of pitch is only slightly lower in this tar than in the high-temperature tars, although the difference would be greater with higher cutting temperatures, or if the distillates had been carried to a pitch of the same melting point in each case, as commercial conditions might demand. Thus, when Carbocoal tar is carried to a pitch melting at 80 deg. C. for use in briquetting, only 56 per cent remains in the still.

Pitch. The pitch obtained from the low-temperature tar was an amorphous, black residue, which lacked the brittleness and lustrous fracture of high-temperature pitches. Briquets made from it lost their sharp edges

³S. W. Parr and H. L. Olin, Univ. Illinois Eng. Exp. Sta. Bulls. 69 (1912) and 79 (1915); T. E. Layng, Dissertation, Univ. Illinois (1915).

⁴F. Fischer and W. Glud, *Ges. Abhandl. zur Kenntnis der Kohle*, vol. 1, p. 114 (1916); *Ber.*, vol. 52, p. 1035 (1919); cf. also *Ges. Abhandl.*, vol. 3, pp. 1, 248, 270 (1918).

⁵H. A. Curtis, *CHEM. & MET. ENG.*, vol. 23, p. 499 (1920); *J. Ind. Eng. Chem.*, vol. 13, p. 23 (1921); G. H. Thurston, *J. Soc. Chem. Ind.*, vol. 40, p. 517 (1921); Wallace Savage, *CHEM. & MET. ENG.*, vol. 19, p. 579 (1918); C. T. Malcolmson, *Bull. Am. Inst. Min. Eng.*, vol. 137, pp. 971, 1686 (1918).

⁶Analysis by Research Laboratory of the International Coal Products Corporation.

⁷J. M. Weiss, *J. Ind. Eng. Chem.*, vol. 10, pp. 732, 817 (1918).

⁸Obtained through the courtesy of the Seaboard By-Products Coke Co., Kearny, N. J. (Koppers retorts); distilled at 850-900 deg. from a mixed coal, avg. 30 per cent V.C.M.

⁹Obtained through the courtesy of the Consolidated Gas Co., New York City; consists of approximately equal proportions of horizontal and inclined retort tars; coal distilled at about 1,000 deg.

¹⁰All temperatures reported in this investigation are corrected for the emergent stems of the thermometers.

TABLE IV—COMPARISON OF TAR AND PITCHES

	Low-Temperature	Coke-Oven	Gas-Works
Crude, dry tar			
Sp. gr. 15.5 deg./15.5 deg.	1.0676	1.1845	1.2172
"Free carbon," per cent	0.71	6.93	20.1
Pitch, cut at 326 deg.			
Sp. gr. 15.5 deg./15.5 deg.	1.134	1.263	1.312
"Free carbon," per cent	2.17	16.8	31.1
Air melting point, deg. C.	53	69	89

within an hour at room temperature. The specific gravity (Hubbard bottle), "free carbon" and air melting points of the Carbocoal, coke-oven and gas-works tars and pitches were determined by standard procedures, and are recorded in Table IV.

The Phenols

The high content of phenols in low-temperature tars has been remarked by nearly all investigators (cf. Table II), and within certain limits may be accepted as an important characteristic distinguishing them from high-temperature tars.

Removal From the Tar. The percentages of phenols were determined separately in each of the five fractions (cf. Table III). In the method used, 100 g. of a fraction was weighed into a 200-c.c. glass-stoppered separatory funnel, and extracted four times each with 50 c.c. of 10 per cent sodium hydroxide solution. The loss in weight of each sample checked against the gain in weight of the alkali used was taken as the percentage of tar-acids present.

Fig. 4 was obtained by plotting percentages of tar-acids against the average boiling points during distillation of the corresponding tar fractions, taken as the mean ordinates of the respective sections of the distillation curve of Fig. 3. It shows a well-defined maximum between 240 and 280 deg., and indicates that a large quantity of tar acids is contained in the pitch.

Purification of the Tar-Acids. The fractions of low-temperature tar were washed completely free of phenols with 10 per cent sodium hydroxide solution. The alkaline solution, after purification by benzene extraction and steam distillation, was acidified with 20 per cent sulphuric acid to liberate the phenols, as indicated by Fig. 1. The tar-acids thus recovered formed a dark brown, slightly viscous liquid, which had a strong odor of cresols.

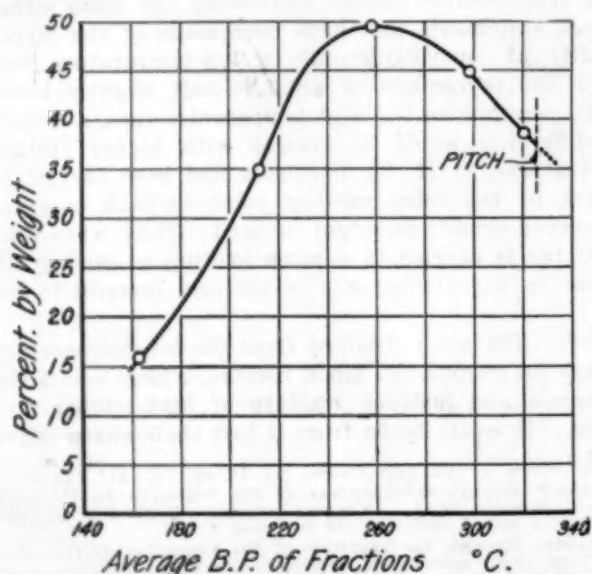


FIG. 4—RELATION OF THE BOILING POINTS OF TAR FRACTIONS TO PHENOL CONTENT OF EACH

Carboxylic Acids. No solubility of this mixture in a saturated sodium carbonate solution could be detected, and a sample after solution in sodium hydroxide was completely recovered by precipitation with carbon dioxide. Carboxylic acids, therefore, could be admixed with the phenols only to a negligible extent.

None of the four investigators quoted above has reported such compounds, but recently Marcusson and Picard¹¹ found in a low-temperature tar from upper Silesian coal a solid mixture of 13 per cent phenols and 12 per cent aromatic carboxylic acids. Tropsch¹² distilled under similar conditions a coal from the same region, however, and found viscous, not solid phenols, with only traces of solid carboxylic acids. He stated that the tar described by Marcusson and Picard was probably exceptional.

Phenol Ethers.—The occurrence of guaiacol in wood-tar¹³ and in peat-tar,¹⁴ both of which are formed by carbonization below 500 deg. and resemble low-temperature coal tars in their high content of phenols, suggests the possible presence in the latter of phenol ethers. A negative Zeisel test, however, showed that methoxyl and ethoxyl groups are absent from the phenol mixture obtained from the low-temperature tar.

A similar result has been reported¹⁵ for the phenols from Lohberg coal tar (cf. Table II).

Polyhydroxy Phenols. The water obtained simultaneously with the tar in the distillation of the coal in the low-temperature process was not available for the present investigation. Since this liquor contained the largest proportion of polyhydroxy phenols distilled from the coal, their estimation in the tar was not attempted.

Catechol has been identified¹⁶ among the products of low-temperature distillation of Lohberg coal, and was estimated to be present to the extent of 0.02 per cent of the weight of the coal.

FRACTIONATION AND DENSITY DETERMINATIONS

The phenol mixture from the low-temperature tar had a specific gravity¹⁷ of 1.036 at 25 deg./4 deg. as compared with 1.044 of the mixed coke-oven and gas-works phenols extracted with 10 per cent sodium hydroxide at 60 deg., and purified in the same manner as the low-temperature phenols. Fractionation curves of the two types are seen in Fig. 5.

It is evident that in the first-named mixture there are no phenols of boiling point higher than may be found among the high-temperature phenols. The proportions of the components, however, differ quite markedly, 52 per cent by volume of the low-temperature phenols boiling below 220 deg., as opposed to 77 per cent of the phenols from coke-oven and gas-works tar. In both cases these percentages may be increased considerably by continued fractionation.

¹¹J. Marcusson and M. Picard, *Z. angew. Chem.*, vol. 341, p. 201 (1921).

¹²Hans Tropsch, *Brennstoff Chem.*, vol. 2, p. 251 (1921); cf. *ibid.*, vol. 2, p. 312 (1921), where he reports 0.49 per cent of carboxylic acids in a vacuum tar from Lohberg coal.

¹³Ossian Aschan, *Brennstoff Chem.*, vol. 2, p. 273 (1921) reports 4.9 per cent of phenol ethers in wood tar.

¹⁴E. Börnsteln and F. Bernstein, *Z. angew. Chem.*, vol. 271, p. 71 (1914); F. M. Perkin, *J. Soc. Chem. Ind.*, vol. 33, p. 395 (1914); *J. Inst. Pet. Tech.*, vol. 1, p. 76 (1914).

¹⁵W. Gluud and P. K. Breuer, *Ges. Abhandl.*, vol. 2, p. 236 (1917).

¹⁶W. Gluud, *Ges. Abhandl.*, vol. 3, p. 66 (1918); cf. W. Gluud and P. K. Breuer, *loc cit.* (ref. 15), and E. Börnsteln, *Ber.*, vol. 35, p. 4324 (1902).

¹⁷Unless otherwise specified, all densities cited in this investigation were determined by use of a Becker analytical balance and a 7 g. glass plummet immersed in the liquid, which was jacketed with water at the desired temperature.

To obtain a more informative comparison of the low- and high-temperature phenols, each series was slowly distilled four times with a Young four-pear head, dividing the distillate into eight fractions. The specific gravity at 25 deg./4 deg. of each was determined, and plotted in Fig. 6 against the average boiling point of that fraction, taken as the mean ordinate of the boiling-point curve of the final fractionation in each case.

The decrease in the specific gravity of the phenols as the boiling point increases indicates the presence of

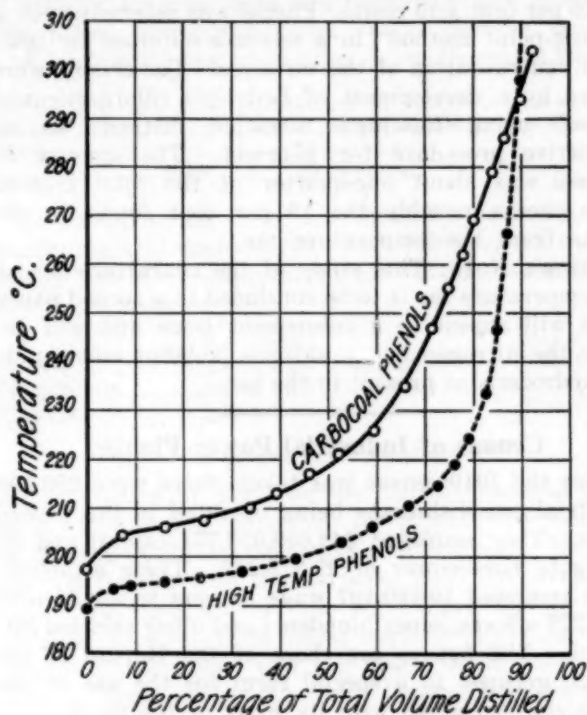


FIG. 5—DISTILLATION OF PHENOLS

aliphatic sidechains of lower density attached to the phenol nucleus—e.g., cresols and xyenols. In the higher homologs a sharp rise in density and a notable increase in the viscosity of the fractions mark the appearance of α - and β -naphthols¹⁸ in the high-temperature phenols, and bicyclic compounds at least in the low-temperature phenols.

These higher homologs have been investigated,¹⁹ and found to contain naphthol derivatives, as the wide divergence of the two curves suggests, but neither α - nor β -naphthol. However, the coincidence of the first section of the curves indicates that the Carbocoal mixture contains the same low-boiling components as the high-temperature phenols, although the proportion is much smaller.

TABLE V—FRACTIONATION OF PHENOLS FROM LOW-TEMPERATURE TAR

Fraction, Deg. C.	Weight in G., Fraction	Per Cent of Total Phenols	No.	Fraction, Deg. C.	Weight in G., Fraction	Per Cent of Total Phenols
1 182-189	41	7.3	6	214-220	44	7.9
2 189-195	38	6.8	7	220-227	14	2.5
3 195-202	60	10.8	8	227-260	102	18.3
4 202-207	71	12.7	9	260-300	92	16.5
5 207-214	48	8.6	10	Pitch	48	8.6
Total					558	100.0

Another sample of the mixed phenols was fractionated once each with a Young four-pear and a 10-in. Vigreux column, and then five additional times below

¹⁸K. E. Schulze, *Lieb. Ann.*, vol. 227, p. 143 (1885).

¹⁹Unpublished investigation of M. T. Bogert and S. Caplan, to whom are due the data in Fig. 6 on the three highest-boiling fractions.

230 deg. with the Vigreux head. The average rate of distillation was 1 c.c. per minute, or 0.2 per cent by volume per minute. The results, corrected for the slight distillation losses, are recorded in Table V.

The specific gravity and bromine tests of Fraction 1 indicated the presence of phenol. Fraction 2 showed with ferric chloride the characteristic color reaction of *o*-cresol. In classifying these fractions it is customary to assume that if the cut is made midway between the boiling points of two components, the quantity of the higher-boiling compound appearing in the lower fraction will be approximately balanced by an equal amount of the lower-boiling compound in the higher fraction. Subsequent experiments have shown this assumption to be justified. On this basis Fractions 1 through 4 contain phenol and the cresols (216 g.; 37.6 per cent); Fractions 5 through 7 contain the xylenols (106 g.; 19.0 per cent); and Fractions 8 through 10 contain the higher homologs (194 g.; 34.8 per cent).

ESTIMATION OF PHENOL AND THE CRESOLS

The general scheme employed is that indicated in Fig. 1. The phenol and cresols, separated from the

TABLE VI—COMPOSITION OF THE LOW-TEMPERATURE PHENOLS

Component	Percentages by Weight, Basis of		
	Phenols	Distillate	Crude Tar
Phenol	4.2	1.9	0.6
Cresols <i>a</i>	33.4	15.2	4.9
Xylenol fraction	19.0	8.7	2.8
Higher homologs	34.8	15.9	5.1
Pitch (acid resins)	8.6	3.9	1.3
Totals	100.0	45.6	14.7

a Ratio: 27 per cent ortho-, 19 per cent meta-, and 54 per cent para-cresols.

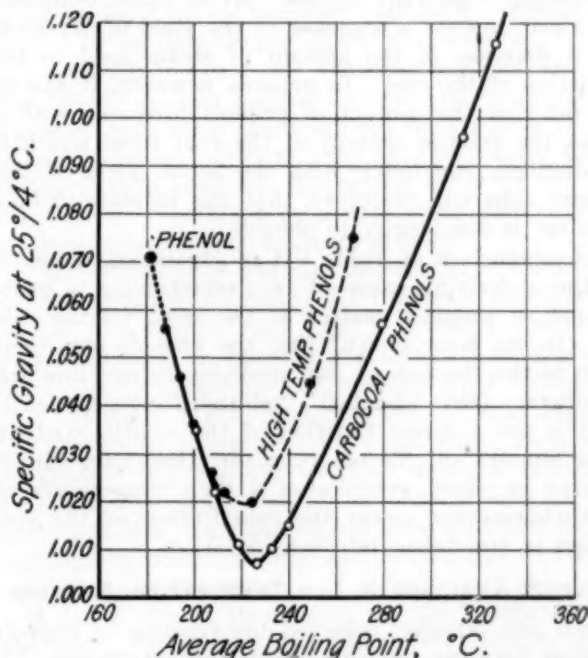


FIG. 6—BOILING POINT VS. SPECIFIC GRAVITY OF PHENOLS

higher homologs by 15 fractionations, amounted to 35.0 per cent (uncorrected for distillation losses; cf. 37.6 per cent above) of the total phenols. Since *m*- and *p*-cresols preponderated in the mixture thus obtained, pure *o*-cresol was added to accomplish a sharper separation by distillation into two fractions, one comprising essentially phenol and *o*-cresol, and the other a mixture of the three cresols.

These fractions were analyzed separately by methods

involving nitration²⁸ and the determination of density and freezing points.²⁹ Table VI shows the composition of these phenols.

COMPARISON WITH PREVIOUS INVESTIGATIONS

The yield of tar in the Carbocoal process from the particular coal in question is 225 lb. per ton, or 11.3 per cent. This is higher than any other yield reported in Table II. The reason for this lies to a large extent in differences in the composition of the coal used by various investigators, as indicated by Table VII.

TABLE VII—COMPARATIVE YIELDS OBTAINED IN VARIOUS INVESTIGATIONS

Investigation	Temp. of Distillation, Deg. C.	Time of Distillation	Per Cent V.C.M. in Coal	Tar Yield Per Cent Coal	Per Cent Tar-Acid Dist.	Tar
Pictet.....	450 max.	5 hr.	15-20	4.0	8
Jones & Wheeler.....	430	5 wks.	26-31	6.5	12-15	6-8
Parr.....	450-525	6-8 hr.	35	8.7	40	28
Morgan & Soule.....	500-600	3 hr.	35	11.3	43	13
Fischer.....	350-500	1-2 hr.	39	10.0	..	50

For the purpose of comparison it may be noted in connection with this table that the distillation of a 30-55 per cent volatile coal in a coke oven at 900-1,000 deg. C. yields from 4 to 6 per cent of tar. The phenols recovered from the coke-oven and gas-works tar mentioned above averaged about 9 per cent by weight of the distillate, or 2.5 per cent of the total tar.

It must be borne in mind in studying these results that Pictet and Fischer alone actually removed the phenols from the entire tar, and that the percentages of tar-acids in the total tars reported by the others are consequently somewhat too low. As an added complication, Parr³ reports a decrease in the yield of tar-acids with a decrease in the amount of steam used in the distillation of the coal. In general, however, it will be observed that the content of phenols increases with a rise in the volatile content of the coal from which it was distilled, and hence with the actual yield of tar. It seems apparent, therefore, that this increase in bulk of the tar is due largely to phenols.

The comparison of Table VII is superficial, however, and the underlying cause of this relationship is probably not so simple a matter as the mere volatile content. It has been shown³⁰ that the phenols owe their origin to the fraction of coal insoluble in pyridine and chloroform (the so-called "cellulosic" constituent), which is not a direct function of the volatile content. A low content of phenols in a tar, therefore, cannot be taken as direct evidence of a high temperature of coal carbonization unless the constitution of the coal distilled is also taken into consideration.

PREVIOUS ANALYSES OF LOW-TEMPERATURE PHENOLS

Jones and Wheeler³ collected the fraction of phenols distilling between 100 and 145 deg. C. at 30 mm. (d. 1.037 at 15 deg./15 deg.), and from its ultimate analysis concluded it to consist essentially of a mixture of cresols and xylenols. Pictet¹ stated that the phenols obtained in fresh Montrambert "vacuum tar" have a

²⁸F. Raschig, *Z. angew. Chem.*, vol. 14, p. 759 (1900).

²⁹J. J. Fox and M. F. Barker, *J. Soc. Chem. Ind.*, vol. 36, p. 842 (1917); vol. 37, 265T, 268T (1918); vol. 39, p. 169T (1920); H. M. Dawson and C. A. Mountford, *J. Chem. Soc.*, vol. 113, pp. 923, 935 (1918). J. M. Weiss and C. R. Downs, *J. Ind. Eng. Chem.*, vol. 9, p. 569 (1917); G. W. Knight, C. T. Lincoln, G. Formanek and H. L. Follett, *ibid.*, vol. 10, p. 9 (1918).

³⁰D. T. Jones and R. V. Wheeler, *J. Chem. Soc.*, vol. 107, p. 1318 (1915); vol. 109, p. 707 (1916); cf. S. R. Illingworth, *J. Soc. Chem. Ind.*, vol. 39, p. 111T (1920).

very high boiling point, crystallize easily and contain no phenol, cresols or xylenols. Among the phenols which appeared on standing in a sample of tar prepared 5 years before, he was able to identify phenol itself, the three cresols and 1:2:4 xynol by qualitative tests.

Fischer²⁸ reported the 45 per cent of phenols from Lohberg gas coal to contain 0.25 per cent catechol, 0.06 per cent phenol, 1 to 2 per cent cresols, 1 to 2 per cent xylenols, 30 to 32 per cent higher-boiling than xylenols, and 10 per cent acid resins. Phenol was determined by a freezing-point method²⁹ in a mixture obtained by fractional neutralization of the tar-acids. The cresols were studied by a development of Lederer's chloracetic-acid method³⁰ using Raschig's nitration method³¹ as an alternative procedure for *m*-cresol. The amount of *m*-cresol was about one-quarter of the total cresols, which checks roughly the 19 per cent found in the cresols from low-temperature tar.

EDITOR'S NOTE: This study of the characteristics of low-temperature tar is to be concluded in a second paper which will appear in a subsequent issue and will describe the nitrogen bases, alcohols, sulphur compounds and hydrocarbons present in the tar.

Census of Industrial Power Plants

When the 1919 census was taken, there were 290,105 industrial establishments being operated in the United States. They employed \$44,688,093,771 capital and an aggregate horsepower of 29,575,242. These establishments employed 10,160,107 wage earners in addition to 1,447,227 officers, superintendents and other salaried employees. The figures are those of the Bureau of the Census, grouped in a special form for the use of the Senate, in connection with its study of the tariff.

The amount of fuel used by these industrial plants is as follows: Bituminous coal, 203,452,724 short tons; anthracite coal, 14,545,300 long tons; coke, 42,764,287 short tons; oil, 92,608,186 bbl.; gasoline, 2,344,469 bbl.; natural gas, 305,768,321,000 cu.ft.; manufactured gas, 38,522,330,000 cu.ft.

At 237,855 of these plants 116,158 steam engines furnished 13,839,744 hp.; 6,472 steam turbines furnished 3,258,235 hp.; 33,407 internal combustion engines furnished 1,259,394 hp.; 13,244 waterwheels furnished 1,753,548 hp.; 817 water motors furnished 22,165 hp. In addition to the foregoing equipment which is owned by the establishment, 9,442,156 hp. is furnished by rented equipment. Of that amount 9,347,556 hp. is furnished by 996,000 electric motors. The remaining horsepower generated with rented equipment amounts to 94,600.

Explosives Production in 1921

A decrease in the quantity of explosives used in the United States in 1921 as compared with 1920 is shown by a falling off of 37.2 per cent in sales of black powder, 25.4 per cent in high explosives, and 23.8 per cent in permissibles. The total sales amounted to 372,107,503 lb., as compared with 537,954,750 lb. the year before. Of this total, 160,021,250 lb. was black blasting powder, 170,952,402 lb. high explosives other than permissible explosives, and 41,133,851 lb. permissible explosives.

³¹F. Fischer, *Brennstoff Chem.*, vol. 1, pp. 31, 47 (1920).

³²Franz Fischer and P. K. Breuer, *Ges. Abhandl.*, vol. 3, p. 82 (1916); cf. *ibid.*, vol. 2, p. 236 (1917); F. Fischer and H. Gröppel, *Z. angew. Chem.*, vol. 301, p. 76 (1917); *Ges. Abhandl.*, vol. 2, p. 178 (1917).

³³L. Lederer, *Frdl.*, vol. 4, p. 91 (1894/1897); D.R.P. 79,514.

Fine Steels From the Acid Open Hearth*

Discussion of the Underlying Principles and Necessary Furnace Practice for the Production of High-Grade Nickel Steel for Gun Tubes and Shafting—Comparison of the Pig, Scrap and Ore Process Used in America With the All-Scrap Practice Used in Europe

STEEL for gun tubes and heavy shafting is usually tested tangentially, and should develop the following physical properties, depending upon its use:

Ultimate tensile strength... 86,000 to 95,000 lb. per sq.in.
Elastic limit 46,000 to 65,000 lb. per sq.in.
Elongation in 2 in. 18 per cent
Contraction of area 30 per cent

To comply with these specifications, especially the maximum, acid open-hearth nickel steels within the following limits of composition are usually supplied by American makers:

	Per Cent		Per Cent
Carbon	0.35 to 0.50	Manganese	0.50 to 0.75
Phosphorus	below 0.05	Silicon	0.15 to 0.30
Sulphur	below 0.05	Nickel	2.50 to 3.75

CHARGING AND MELTING

Forty parts of pig iron are usually charged to 60 parts of scrap, not more than 20 per cent of which may be turnings (which oxidize badly in melting). Half the pig iron is put into the furnace, then the scrap, and finally the remainder of the pig. Thus the top layer protects the scrap from undue burning caused by direct impact of the flame, and the lower layer reduces the oxidized drops of molten metal before they reach and corrode the hearth beneath. Composition of the mixture is as follows:

	Per Cent		Per Cent
C	2.0	Mn	1.0 to 1.25
P	less than 0.05	Ni	less than specification
S	less than 0.05	Cr	less than 0.05

Melting should be done with expedition, since the hearth is attacked more or less severely during the early hours.

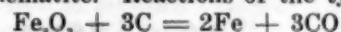
Sulphur and phosphorus, being substantially unchanged during the heat, should be low. Both of these elements segregate toward the axis of the ingot, and also at the surface of primary austenite crystals, and on forging result in black ghost lines. A surprising amount of manganese remains in the metal, and is throughout a very powerful deoxidizer and desulphurizer. Chromium intensifies the tendency toward laminated fractures in the finished forging, and should be kept to the extreme minimum.

ORING

When the charge is well melted it contains 0.90 to 1.20 per cent C, which must now be removed. A preliminary step is to add 10 lb. CaCO₃ per ton of charge and stir it in. It gives off CO₂ gas, which bubbles up through the metal. Boiling or chemical stirring aids the mechanical stirring in heating the cold metal at the bottom of the bath. Cold metal mixes with the hotter upper layers, which in turn have received radiation from

flame and roof. The CaO remaining also forms a fusible slag with the oxides formed during melting.

As shown in Fig. 1, in about 45 minutes the temperature of the bath is hot enough so that small amounts of cold ore thrown in from time to time will not chill the adjacent metal and slow down the reactions. For each ton of metal is added 28 to 33 lb. of rich, pure low-phosphorus hematite. Reactions of the type



take place; the liquid boils violently. In about 2 hours oring should be complete, the carbon then being some 0.30 per cent above the desired figure, a margin which is needed in the subsequent operations.

DEOXIDIZING

A rather thin line exists between the oring and the deoxidizing period. In the former, iron oxide was added to rid the bath of excess carbon. Now comes a time when the object is reversed; the reaction is the same, but the residual carbon is used to rid the bath of excess oxide.

Carbon is a good deoxidizer to use, since the product is a gas which easily escapes. In order to proceed with reasonable speed the reaction requires a very high temperature, as high as the roof can stand. Progress is judged by the appearance of the slag crust adhering to furnace tools—as the slag contains less and less FeO, the freshly broken sample becomes more vitreous or waxy, and the color changes from dark brown or black to pale lemon and then to light gray.¹ Toward the end of the carbon reaction, decreasing oxide in the metal may also be recognized by a decreasing number of gas cavities in test ingots, taken periodically.

The principles of physical chemistry indicate that a soluble oxide will distribute itself between two liquids in contact in a definite ratio (which is constant as long as such conditions as temperature and nature of slag remain fixed). Therefore, as the slag loses FeO, it is a sign the metal is also losing oxygen. A light gray slag contains about 15 per cent FeO, and when the heat has progressed this far, the reaction between carbon and FeO has been nearly halted. In fact during the later portion of this stage carbon has been attacking the slag and hearth, reducing SiO₂ and adding up to 0.12 per cent silicon to the metal.

It is of utmost importance, in the manufacture of fine steel, that this high-temperature refining of the metal by carbon be carefully attended and pushed to completion.

When the carbon has fallen to approximately that percentage required for the finished product, as judged by the fracture of a test ingot, a rapid carbon analysis is made, and the word passed to "go ahead" with prepa-

*A digest of a paper entitled "Acid Open-Hearth Process for Manufacture of Gun Steels and Fine Steels," presented by W. P. Barba and Henry M. Howe before the February meeting of the American Institute of Mining and Metallurgical Engineers.

¹The outer surface of slag samples is always brown, like glazed tile, doubtless on account of oxidation of the cooling ferrous oxide. Use of high-manganese pig has a considerable influence on these slag samples, giving them a strong greenish cast and at times a dark green core. Appearance is also affected by the rapidity of melting, and the kind of hearth, and excessive drippings from the roof.

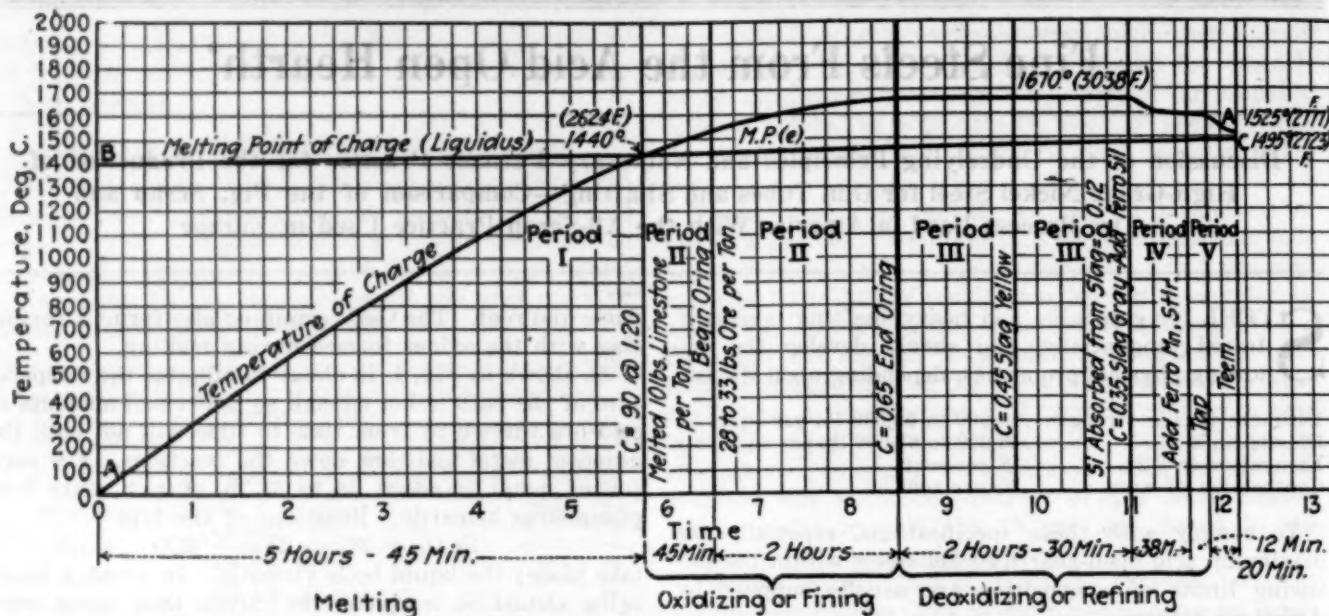


FIG. 1—APPROXIMATION TO A TIME-TEMPERATURE DIAGRAM OF THE ACID OPEN-HEARTH PROCESS ON GUN STEEL

rations for tapping. Further decarburization is halted and deoxidation continued by adding ferrosilicon to the intensely hot bath. This melts quickly, alloys with the metal, and the silicon is rapidly oxidized to silica, which in turn joins with additional basic oxides to form fusible silicates. In a hot bath the resulting silicate particles coalesce, rapidly rise and enter the slag. (It is evident that nearly but not quite enough ferrosilicon should be added to complete the oxidation. If an excess were used, infusible silica inclusions would remain in the finished steel.) Activity of the carbon is further reduced by lowering the temperature by shutting off gas and air and closing the stack damper. Cool areas will quickly show darkly on the quiet slag surface. At this time—the close of period IV of Fig. 1—equilibrium has apparently been reached, and very little change will be noted in the chemical composition of the metal if held in the furnace for many minutes.

Within 40 minutes after the silicon is added ferromanganese is added and stirred in. The bath may possibly contain 0.10 per cent manganese; if 0.73 per cent is added, the resulting ingot will contain about 0.65 per cent Mn, conforming to specification. An apparent loss of not more than one-tenth the addition is an excellent indication that deoxidation has previously been well done. Larger losses in heats which are apparently normal are associated with uncertain metal which should be watched with great care. (Segregates of manganese silicate would doubtless be found in the axial region of the ingot; owing to its fusibility it would remain liquid to the last, and would have a correspondingly enhanced opportunity to coalesce into sizable particles.)

After 12 minutes the diffusion of manganese should be complete. Slag is gray or greenish gray, and the metal is tapped from the furnace to the ladle, held about 20 minutes, when the temperature will be close to the liquidus and proper to pour into very large ingots. Use of aluminum, titanium or vanadium, not as alloying elements but as final deoxidizers or scavengers, should be avoided, since their efficacy will be a direct measure of the temptation to use them to cover up careless furnace practice. They form infusible oxides which remain included in the steel.

It should be apparent that in acid bottoms silicon

should be used before manganese. If the latter were added first, it would form basic oxides with the oxygen in the metal, and these would take silica from the hearth to form a fusible slag. Much more alloy would be used, much more damage done to the furnace and much more slag would have to be eliminated from the metal. The arguments and procedure are evidently reversed for basic practice.

SUMMARY²

(1) "The steel should be brought at the moment of teeming to the desired composition in every respect.

"The manganese and silicon must be brought to the desired proportion. In order to do this, the bath should be freed from oxygen as nearly as possible and certainly to a constant degree. This freedom from oxygen is important also for lessening or preventing segregation, blow-holes and structural metallurgical weakness.

"Phosphorus and sulphur must be below the prescribed limit, and to this end the stock must be sufficiently free from them.

"The chromium and nickel must be within the prescribed limits.

(2) "The temperature must be accurately regulated.

(3) "Retention of inclusions must be restrained by deoxidizing the molten steel as fully as possible by means of the carbon of the pig iron, because the product of its oxidation is gaseous and escapes, whereas those of all other deoxidizing agents are solid or molten and tend to remain as inclusions. In order that as much as possible of the deoxidation should be done by carbon, the working temperature during refining must be held as high as the safety of the roof will permit.

(4) "The nearly complete deoxidation by carbon should be followed by further deoxidation by silicon. The manganese should not be added till after this silicon has done its work of deoxidation, in order that as little as possible of it may oxidize. This is both so that the manganese content of the product may be as nearly constant as possible, and that as little manganese oxide as possible may form to corrode the siliceous hearth of the furnace and form inclusions of manganese silicate with the silica so eaten away. This postponement clearly tends to lessen the oxidation of manganese;

²In the words of the authors.

first, by shortening its stay in the furnace and, second, by pre-deoxidizing the bath with the silicon.

(5) "The steel should be held in the ladle a moderate length of time to allow the inclusions to rise to the surface, and also for the much more important purpose of permitting the finished steel to fall to the proper temperature for casting into a successful ingot.

(6) "The furnace itself must be protected. To that end its hearth should be protected from iron oxide by covering it, before charging the scrap, with about half of the pig iron used.

"The working temperature of the furnace must be maintained during the melting and refining periods at the highest point consistent with safety to the furnace: First, so as to shorten the melting period, during which the hearth is exposed to the attack of the iron oxide, because it is not fully covered by the molten charge; second, so as to stimulate the deoxidizing action of the carbon of the bath during the refining period.

(7) "In all respects the working conditions should be brought as nearly as possible to a fixed standard, because it is difficult to compensate for the results of even minor variations in procedure."

COMPARISON WITH EUROPEAN PRACTICE

Typical French and Italian practice uses much less pig iron in the original charge, so that when melted the metal has but 0.10 to 0.20 more carbon than desired in the finished steel. Oring is therefore unnecessary, and period II of Fig. 1 is omitted; refining the bath of oxygen acquired during melting proceeds immediately by reaction with the surplus carbon. If carbon reaches specification before the bath is deoxidized, more carbon is added by periodically adding pig iron, coke or both until the desired condition is arrived at. In some works coke is made to float on a deoxidizing slag, specially made up by additions of lime, clay, sand and fluorspar, until the slag test is green and reactions in the bath cease. Even after this the charge is held for 1 hour at a very high temperature to permit the inclusions to rise and deoxidation to be completed.

Oring allows the use of a larger amount of pig iron, which may be not only more readily accessible than high-quality scrap, but also cheaper. However, it increases the time and correspondingly the fuel bill per ton of product.

Boiling or chemical stirring is a valuable aid in keeping the metal hot enough without destroying the furnace. It is fortunate that the boil is present in a metallurgical practice which produces a heavy blanket or slag, when a maximum of stirring is necessary.

Oring also furnishes some iron and thus increases the yield, but this is not a valid consideration in the manufacture of fine steel.

On the other hand, high pig charges cause thick slag blankets and a correspondingly large amount of material to deoxidize before the metal is quiet. Furthermore pig iron can be refined only by oring, which introduces oxide into the metal, the very thing we are later at such pains to eliminate completely.

It should be remembered, however, that even the act of melting heavy scrap in an open-hearth furnace will oxidize the metal so that refining is necessary; furthermore, that it is the last stage of purification which requires the highest skill—a stage which cannot be avoided in either practice. Even though Americans judge the progress of deoxidation in the metal by the

slag appearance, deoxidation is actually done by reaction of carbon and iron oxide in the metal, and this is later reflected by a diminished content of iron oxide in the slag. Slag, therefore, is always a step behind the metal, and a satisfactory slag test is proof that the metal has been in good shape for some time. This is an advantage much stressed by American metallurgists. They point out that when the slag is also being deoxidized by coke, its condition is not indicative of the reactions which are going on underneath, even though these reactions may proceed to completion more rapidly.

Physical properties of steels from comparative heats, where the only variable was the presence or absence of the oring stage, are not available for use as an indication of the relative weight which should be given the above considerations.

U. S. Production of Refined Primary Lead in 1921 Compared With Preceding Years

An estimate of the production of lead in the United States during 1921 made by the U. S. Geological Survey is given below, in comparison with figures for preceding years:

	1919 (Short Tons)	1920 (Short Tons)	1921 (Short Tons)
Domestic desilverized lead.....	208,751	220,327	187,962
Domestic soft lead.....	147,744	189,854	157,513
Domestic desilverized soft lead.....	67,938	66,668	52,747
Foreign desilverized lead.....	424,433	476,849	398,222
	57,787	52,808	50,367
Total refined primary lead.....	482,220	529,657	448,589
Antimonial lead.....	13,874	12,535	10,064
APPARENT CONSUMPTION OF REFINED PRIMARY LEAD IN THE UNITED STATES — (REFINERY STOCKS DISREGARDED)			
Supply:			
Stock in bonded warehouse Jan 1.....	472	234	1,322
Imports of pigs, bars, and old.....	5,107	35,719	31,301
Production.....	482,220	529,657	448,589
	487,799	565,610	481,212
Withdrawals:			
Exports of foreign lead—			
From warehouse.....	40,976	17,363	25,000
In manufactures, with benefit of drawback.....	1,936	6,175	9,369
Exports of domestic lead.....	10,510	2,730	1,624
Stock in bonded warehouse Dec. 31.....	234	1,322	347
	53,656	27,590	36,340
Apparent consumption.....	434,143	538,020	444,872
Lead content of ore and bullion in bonded warehouse Dec. 31*.....	45,476	51,220	19,186
Average selling price in cents per pound.....	5.3	8.0	4.5

*Some part of this may have been smelted and refined and thus be included in the quantities given above as "Foreign desilverized lead."

Tanning Sole Leather With Sulphite Liquor Investigated by Bureau of Standards

The investigation of the durability of sole leather filled with sulphite cellulose extract as compared with sole leather filled with ordinary vegetable tanning materials has been completed and will appear shortly as a technologic paper of the Bureau of Standards.

The results show that sulphite cellulose extract is as firmly fixed in the leather as the ordinary vegetable tanning material and that leather filled with it is as durable as leather filled with such materials as chestnut and quebracho.

Occupational Figures for Chemical Industries

Chemical industries employed 74,289 persons as laborers when the 1920 census was taken. This compares with 41,741, the figure shown in the 1910 census. Semi-skilled operatives totaled 50,341 in 1920 and 30,705 in 1910.

Chemists, assayers and metallurgists, engaged in the practice of their profession, in 1920 numbered 32,941. This compares with 16,273 in 1910.

Metallic Sodium—II

A Critical Review of the Processes Which Have Been Developed for the Preparation of Metallic Sodium by Chemical Reduction—Difficulties Encountered — Chronologically Arranged Bibliography Covering the Metallic Sodium Industry*

BY HOWARD E. BATSFORD

FROM the earliest times there have been attempts made to get metallic sodium from its salts by chemical reduction. The basic principle in all these experiments was that of reduction by some form of carbon at a temperature high enough for fusion of the salt and volatilization of the metallic sodium. The sodium was then condensed in a suitable manner.

In 1879 W. P. Thompson mentioned a process in which molten iron alone or in combination with hydrogen or coke was the reducing agent. Iron, mixed with a great deal of coke, was heated in a sort of bessemer converter with caustic soda; and the sodium formed was distilled off.

In 1883 C. A. Faure patented a process for making sodium by reduction of Na_2CO_3 . He used a furnace composed of a refractory material, such as compressed magnesia. Electrical conductors were imbedded in the bottom for heating the contents, and holes were left in the top for supply of material and escape of gas and the vapor of sodium.

In 1884 S. G. Thomas used wrought- or cast-iron retorts or tubes with thick lining of refractory material unacted on by sodium. The mixture of Na_2CO_3 and carbon was fed continuously in the current of hot reducing gas. The sodium vapor was condensed from the gases.

In 1886 Dr. E. C. Kleiner-Fiertz reduced the sodium salts by fusing in an arc between two electrodes in a carbon-lined retort.

C. S. Bradley and F. B. Crocker reduced sodium by heating a charge of Na_2CO_3 , charcoal and chalk in a hollow cylinder of wrought iron heated by passing a current through it.

St. Clair Deville made a mixture of the following proportions for the reduction: Na_2CO_3 , 30 kg.; coal, 13 kg.; chalk, 5 kg.

The chalk has no chemical effect on the reaction, but it is added only to make the mass tacky and not fluid.

All materials were pulverized and screened, then mixed and again passed through a screen, after which they were heated to a red heat in an iron crucible, sintered strongly together and finally converted to a pasty consistency. They were removed from the crucible and transformed into a coarse powder on cooling, the last-named being put into the reduction vessel.

He used as pure soda ash as possible, since the ordinary calcined soda of commerce always gave poor results, containing foreign salts which raised the melting point.

In 1887 J. B. Thompson and W. White invented a process for intimately mixing dry Na_2CO_3 with a liquid

carbonaceous material, preferably tar; it was then heated to a dull red heat in iron pots by the waste heat of flue gases. When all volatile matter was consumed, the charge was distilled in a fireclay tubular retort, connected with a tightly closed receiver, containing paraffine oil to insure a non-oxidizing atmosphere and also provided with an escape pipe for CO_2 .

O. M. Thowless improved previous methods of sodium production by introducing the NaOH or other compound preheated into the previously heated carbonaceous matter.

In 1888 several patents were issued, as the metal sodium was beginning to be studied very seriously.

H. S. Blackmore heated the following mixture to dull redness for 20 minutes and then to a white heat:

27.5 parts of $\text{Ca}(\text{OH})_2$	30.9 parts of dry Na_2CO_3
31.1 parts of Fe_2O_3	10.5 parts of charcoal

Caustic soda was first produced, and the organic matter reduced the ferric oxide to metallic iron, which in turn reduced the soda; the metallic sodium distilled off and was suitably condensed. After slaking, the residue of ferric oxide and quicklime was used again.

A. B. Cunningham fused caustic soda in an open vessel and mixed pulverized carbon with it. He introduced the charge while still liquid into a red-hot retort. The fumes of sodium were condensed.

C. A. Jarvis proposed the use of fireclay apparatus in order to prevent the large amount of corrosion which takes place when iron crucibles or tubes are used.

NETTO PROCESS

C. Netto heated a column of coke or charcoal in a retort or receiver to a high temperature. The NaOH was fused and run in, falling as a spray on the red-hot charcoal. It was decomposed very rapidly and the vapors of sodium were able to escape freely between the lumps of charcoal into the receiver.

He further improved his process by continuously feeding fused NaOH into the top of a furnace with a condenser at the top and with a hydraulic trap at the base. The retort was filled about one-half with incandescent charcoal. The sodium distilled over and the Na_2CO_3 produced ran down to the bottom of the retort where it could be siphoned off continuously or intermittently, and thus be prevented from interfering with the continuous action of the process. Sodium by this means could be produced at a much lower temperature and more regularly than when the carbonate was not removed.

H. W. Wallis powdered "hydrated alkali" and mixed it with 10 or 15 per cent of carbonaceous material, which was also pulverized. This mixture he fed at intervals into a heated retort.

In 1889 W. G. Forster introduced coal gas or carbonaceous vapor or other reducing gas or vapors

*For Part I see CHEM. & MET. ENG., vol. 26, No. 19, p. 888, May 10, 1922.

Note: Complete references to all the work discussed will be found in the chronologically arranged bibliography at the end of the article.

through a perforated pipe immersed in the fused alkali, distilled the sodium over and condensed it.

T. Parker and A. E. Robinson mixed carbonates, hydrates or oxides of sodium with a quantity of finely divided carbon sufficient to reduce them to the metallic state and heated them by means of "an electric arc or electrical resistance," the metal volatilizing and being condensed. The electrodes used could be of iron, and a liquid bath of iron or other metal might be maintained at the base of the furnace for heat diffusion. The charge was heated before entrance to economize current.

In 1890 the work on the electrolytic production of sodium was given an impetus by Grabau, and during the next ten years little was apparently done on chemical reduction.

In 1899 C. Wolfram introduced a process for reacting calcium carbide with molten caustic soda. He obtained Na_2CO_3 and sodium. By melting salt and introducing carbide he was able to get particles of sodium to come up and float on the bath.

In 1903 T. Parker mixed aluminate of soda with carbon in suitable proportions and calcined them in an electric furnace. Sodium distilled off and alumina was left. In his proposals he also mentioned the use of silicates, from which carborundum was recovered as a secondary product.

During the same year H. Specketer and C. H. Weber invented a process for making sodium by subjecting sodium fluoride to the action of metallic aluminum, having the salt just above the melting point.

MEHNER PROCESS

The electrolytic processes of Castner, Darling, Ashcroft, Carrier and others dominated the field and there was little mentioned in literature about chemical reduction till 1912, when H. Mehner proposed to react soda with molten cast iron in such a manner that the sodium metal was set free in vapor form and carbon monoxide was formed. The carbon was returned to the iron by known methods, or the old iron was removed and replaced by new. The reaction was highly endothermic, and the highly heated mass of cast iron was efficacious in furnishing both carbon and extra heat.

In 1913 Swann and Kendall distilled Na_2CO_3 and carbon and conducted the sodium vapor through fused NaOH to condense it from its admixture with CO .

In 1919 H. Freeman proposed to make sodium by treating salt with calcium carbide in a manner slightly different than Wolfram. The present process consisted in mixing the finely powdered substances and heating them to a bright red temperature, not higher than 1,400 deg. C.

The great troubles with the early processes seemed to lie in the difficulty of getting apparatus which would stand the action of the sodium at the high operating temperatures, and also the difficulty in getting the sodium vapor removed from the reduction vessel and condensed. From the author's experience with sodium distillation it seems highly probable that quantities of salt and other impurities were entrained with the sodium vapor and remained to contaminate the finished product.

With the gradually increasing cost of electrical power and labor it seems possible that some chemical reduction method may be able to compete successfully with the electrolytic ones. Men are now working on this problem,

as is evidenced by the patents coming out from time to time, and also by the fact that sodium may be used for several of the intermediate manufacturing processes, as well as for making peroxide bleach and sodium cyanide.

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The Technical Man as a Citizen*

BY ACHESON SMITH

NEVER in the history of our country has there been such a pressing need for an intelligent citizenry. The post-war problems are of such a nature that it is difficult to understand them and consequently almost impossible correctly to solve them. Various solutions are offered for the same problem, and to the great mass of people, unfamiliar with the technical side of a question, a man with an unsound penance will appear to be just as safe to follow as the man who is a real authority on the subject.

The tendency is to look to our government for aid, and as governmental aid is usually legislative, all kinds of legislation are proposed or enacted. In the opinion of many our revenue laws can be made to contribute to the prosperity of the country, but their provisions always provoke controversy and the final enactment is usually a geographical and personal compromise. Our financial system is constantly subject to attack and there is an effort being made at present to alter it so as to make money more plentiful. Laws relating to our agricultural, mineral, water-power and other natural resources should be drawn with the greatest care, for upon their wise development will depend much of the future wealth of the nation. Regulatory legislation is being urged more and more, and while its purpose may be very laudable, the carrying out of such laws requires so many enforcement officers that we are adding a burden to ourselves which has a doubly bad effect. First, it requires the expenditure of a great deal of money to enforce such regulation, and secondly, it takes a large number of people who might be producers and places them squarely in the unproductive, official class.

COUNTRY CONFRONTED BY SERIOUS PROBLEMS

Many other serious problems are before the country and the world today. For instance, the supremacy of the white race is being challenged by those whose color is black or yellow, and the white race can maintain its position only by raising the intelligence of its leadership.

It is perhaps natural, under our form of government, for the proletariat to put great faith in political laws and to be blissfully ignorant of the fact that where such laws are not based upon sound economic principles they will sooner or later prove futile. The futility of political laws when they are contrary to the economic needs is well illustrated by the conditions now prevalent throughout eastern Europe. Much more could be said on this subject, but it will probably suffice to add that the future success and safety of our country will depend upon the intelligence of its leaders.

When Lord Macaulay wrote his famous letter in which he expressed doubt about the ultimate success of Jeffersonian democracy, he said that "such democracy would sooner or later destroy liberty." We are now evidently in the process of being tried to see if this republic can endure. It is comparatively safe from external enemies, but if we do not act wisely and in conformity to sound economic law we may be destroyed by our own acts, in spite of our good intentions. The

times, therefore, call for strong men; men who have knowledge, men who have been taught to reason and to be guided by fact. This type of man being demanded, none are better able to qualify than chemists, engineers and other technical men.

"THE AGE OF THE ENGINEER"

We often hear the statement that this is the age of the engineer, but it is possible that we do not understand the full significance of that phrase. The present advanced state of civilization is mainly due to the technical men. That we have more comforts and luxuries today than we could have had a hundred years ago, and at the same time have more leisure for study and recreation, is due to the greater productivity per man, due to labor-saving devices, improved processes and administrative methods. If production per capita had not increased, we would have little time for the fine arts, and no means with which to sustain those who would devote their lives to such pursuits. If we desire to visualize what the world owes to the technical man, all we have to do is to consider what would happen if our steam and electric power and all machinery and modern chemistry were taken away from us. We would have to reorganize society, and each one would be so occupied in producing the necessities of life he would have no time to produce non-essentials, and very little if any time to enjoy them.

The present standard of living among our laboring people is solely due to the engineer. For example: If a farmer is able to produce only enough to feed and clothe his family, he has no time for the finer things of life and cannot afford any luxuries. If, however, he can produce twice as much as is necessary to feed and clothe his family, he will have a surplus with which he can purchase luxuries. The number of luxuries he can buy will depend upon their cost, and therefore the cheaper they can be produced the more he can purchase. We thus see that the greater productiveness of the farmer enables him to acquire luxuries, and the greater the productiveness of those who manufacture them the cheaper these will be, and therefore the more the farmer can purchase. As the ability of the farmer and manufacturer to produce is largely dependent upon the implements and methods supplied by the engineer, we can see that upon him rests the responsibility for future progress and the credit for what has already been accomplished.

INCREASED PRODUCTION RAISES LIVING STANDARD

Putting it another way: The greater our productiveness the fewer people it will require to produce the necessities of life, and therefore the greater number that can be spared to work in art, medicine and other pursuits that contribute so definitely to our pleasures and comforts. In fact, our present standard of living can be maintained only if we keep up our production, and it is certain that the standard of living cannot be raised unless we increase our production per capita. As our increased production is due to the technical men, we see that the whole material progress of the country depends upon progress in pure and applied science.

If the things that make life worth while are ours because of greater productivity, it follows that we should honor the producers and do everything we can to educate all to the necessity for producing beyond their needs. The greatest incentive so far discovered to induce people to produce beyond their immediate

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Note: The terms engineer, chemist, technical men, etc., are used synonymously, and are meant to include all men working in pure and applied science.

requirements is the principle of property rights. When a man knows he can enjoy the products of his labor he will produce beyond the needs of the day, but if he is in doubt about being protected in such a right he will be without the incentive to produce a surplus. Therefore, we, as men who understand the tremendously serious effect of withdrawing or endangering such right to the enjoyment of property, should guard it zealously as the bedrock of civilization. While it sounds rather utilitarian to preach the gospel of production and property rights, it should be remembered that culture and the finer things of life presuppose leisure, and the amount of leisure we possess is in direct relation to the surplus of life's necessities which are produced per man.

THE ENGINEER SEEKING RECOGNITION

In view of what has been accomplished by the engineer it may sound strange to say that he is seeking recognition, but such is the case. Nearly every technical society has had meetings and papers on such subjects as the status of the engineer. Practically all of the technical publications have had articles lamenting that the technical man does not take his proper place as a citizen and is not found in our legislative bodies. Comparatively recently a Federation of Engineering Societies was formed for the purpose of increasing their influence at Washington. Many articles could be cited wherein it is pointed out that the engineer should have greater recognition, and suggesting ways by which that very desirable end could be attained. It is evident that among the technical men of the country there is a feeling that they do not occupy as influential a position as they should.

If technical men are the leaders in science and industry, and no one will dispute that they are, and if they seek recognition, it must be in civic and political fields. The question, therefore, arises, What can the engineer do to procure such recognition? The matter has been discussed at considerable length, and the engineer should now take definite action toward attaining the position he seeks.

If we distinguish between the effort to force recognition through strength of numbers and the recognition gained by the profession through its individual members becoming influential, we shall see that recognition of a group or class is difficult to procure and more difficult to maintain, while recognition of individuals is a natural force which extends throughout our whole political system. It is not desirable that engineers exercise influence as a class, but that they as individuals gain a position of influence. The first would be artificial and uneconomic, while the latter would be very desirable and perfectly sound, because the struggle for success as individuals builds character, while the success of a class does not.

If we examine the political organization of our country, we shall find that overlapping spheres of influence exist, reaching from the humblest community to the highest official circles in Washington. An individual becomes active in the political and civic affairs of his own locality and is brought into contact with other similar individuals, who together form the dominating group in the city. A few from each city make the controlling group throughout the state, and a group from the various states are the influential men in the nation. These men are the real leaders and those who would take an active part in our body politic must be

willing to work as these men are working. We must realize that the political machinery which controls our government is an actual fact, and if we are to become influential in the nation's affairs we must recognize the rules of the game and play accordingly. We, therefore, see that the leaders in the country are those who do a citizen's duty and a little more, over a term of years, and as a result find themselves the influential men in their community. Here is an opportunity for the engineer to do his locality a substantial service and at the same time put himself in a position of real influence in the state and nation.

Under a system of government where the illiterate and men of low ideals have an equal voice with the educated and men of high ideals, the only thing that can prevent liberty from destroying itself is intelligent leadership. The technical men of the country should, therefore, start to work, each in his own community, and see if we cannot in a generation or two raise the standard of leadership so that sound thinking shall become the dominating influence in our legislative bodies.

The engineer is justified in striving for a high degree of technical attainment, but he should not lose sight of the fact that if he does not have the ability to lead he will probably not get very far in his chosen profession nor in the civic field. The qualities of leadership must be developed, and there is probably no better way to begin than by taking a minor part in political affairs, working in civic bodies and taking an active part in at least one technical society. A man who is not willing to give a portion of his time and talents to his technical society has lost sight of the fact that by doing so he will develop himself as well as advance the interests of the profession. It is not what he takes in but what he gives out that constitutes his contribution to the world's work, and unless a man can become constructive he cannot hope for success. By taking an active part in civic affairs he will benefit his home community and at the same time be training himself to be a leader.

NEED FOR EDUCATED MEN IN CIVIC LIFE

While it is quite necessary that a man make himself proficient in his chosen line of work and avoid such things as would seriously interfere with such development, he should remember that this is a government of and by the people, and if he does not do his share someone is doing it for him and probably doing it less ably than he could do it. He might well heed the words of Herbert Spencer: "The man expending his energy wholly on private affairs, refusing to take part in public affairs, pluming himself on his wisdom in minding his own business, is blind to the fact that his own business is made possible only by the prosperity of all."

There is a great need for educated men in all strata of civic and political endeavor, and the university-trained men can render wonderful service if each one will do his part. If a technical man does not gain the position of influence he seeks he either does not have sufficient ability or he is unwilling to do the necessary work. If, however, the engineer will remember that he is a citizen as well as a technical man and develop himself by serving his own locality, he will some day be surprised and pleased to find that his influence extends beyond his community and is perhaps felt throughout the nation. Thus by his personal attainment he will help in procuring deserved recognition for the technical profession.

Recovery and Utilization of Cyanide From Byproduct Coke Ovens

Cyanogen Compounds Available in American Coke-Oven Gas Are Adequate to Supply Our Entire Demands—Description of a Process for the Direct Recovery of Hydrocyanic Acid and Sodium Cyanide—Possible Replacement of NaCN by HCN

BY EDWARD V. ESPENHAHN

THE LARGE coke-oven installations in the United States and Europe present a source of supply of cyanide, which so far has not yet been exploited to any appreciable extent. Although the ferrocyanides are obtained by indirect methods from coal-gas works, the simple cyanide salts of the alkali metals are usually produced synthetically. The desirability of removing the hydrocyanic acid from coal gas at such works is generally recognized, but usually the conditions are not favorable for this recovery primarily because of the relatively high installation and operating costs. These disadvantages, however, do not exist at coke-oven plants, or at least to such an important extent, since much larger quantities of coal are carbonized at these plants and overhead expenses are correspondingly low.

The failure to recover cyanide at coke ovens at the present time may be attributed to the indirect methods hitherto adopted, and it is the opinion of the author that should these sources be exploited economically direct recovery methods must be resorted to. When coal began to be coked on a large scale in byproduct ovens, it was early recognized by coking technologists that the indirect methods of ammonium-sulphate recovery, whereby the ammonia of the gases is first absorbed by scrubbing with water, from which it is distilled by steam before being reabsorbed in sulphuric acid, were no longer suited for large-scale operation. The direct processes were then devised and have been almost universally adopted for the recovery of ammonium sulphate. The gas is passed directly through a bath of a saturated ammonium sulphate solution, which is kept slightly acid, between 50 and 80 deg. C., from which the precipitated salt is removed and washed by mechanical means. About the only instances where indirect processes are still employed is where a good market is obtainable for liquid ammonia, such as in the ammonia-soda process. Should cyanide recovery eventually be adopted at coke-oven plants, it might be expected to follow this history of ammonia recovery, wherein indirect methods hitherto used were discarded and superseded by direct and economical processes.

It is the purpose of the present article to describe such a process for the direct recovery of cyanogen compounds from coke-oven gas, but before such a description is attempted, it is believed that a brief review of the consumption and uses of cyanides will be of interest.

CONSUMPTION OF CYANIDES

The cyanide and ferrocyanide or prussiate salts of the alkali metals are among the most important inorganic chemicals used in the industrial arts. The consumption of the former in this country amounts to tonnages represented by five figures and the consumption

of the ferrocyanides is somewhat less than half that of the simple cyanides. Statistics compiled prior to 1914 do not permit a survey of the separate sources of the cyanide salts, but in that year the imports and domestic manufacture amounted to 12,000 tons; in addition 3,250 tons of potassium ferrocyanide was consumed.¹ These tonnages from foreign and domestic sources were about evenly distributed. In 1919 about 11,000 tons NaCN was consumed, 25 per cent of which was imported. The consumption of sodium ferrocyanide was over 4,000 tons, of which 15 per cent was obtained from foreign countries.

Mexico is also one of the largest consumers of cyanide, where it is used mostly in treating silver ores. Practically all of the salt is imported from Europe, and the total Mexican consumption may be estimated to be at least 3,500 tons and perhaps may amount to 5,000 tons. Furthermore, at least 1,200 tons is used in Canada yearly.

Owing to abnormal business conditions, there was a decrease in the consumption of cyanide during 1920 and 1921, so that the year 1919 probably represents the best index of future requirements. It is rather remarkable, however, that the consumption has been maintained to such an extent while gold mining was at such a low ebb, although silver mining remained fairly steady. These indications point to the fact that other important and equally extensive uses have been found for this chemical. With prospects of the price being reduced to the pre-war level, a further impetus will be given for its consumption, especially along new avenues, which will be discussed in the following paragraphs.

USES OF CYANIDE

Sodium cyanide and potassium cyanide, or mixtures of the two salts, are used principally for (1) extraction of gold and silver from ores; (2) generation of HCN for fumigation of fruit trees and eradication of rats and other vermin; (3) case-hardening of steel; (4) electroplating; and (5) miscellaneous uses, such as in the synthesis of dyes and other organic chemicals.

Comparing the first two uses, it does not seem improbable but that the importance of the chemical in gold mining has been relegated to an inferior position by the increased demand of cyanide by horticulture. The use of HCN for fumigating citrus trees is now firmly established in California, and although only one-third of the 20,000,000 trees in bearing are treated, it is claimed that from this third the bulk of the crop is obtained. The treatment provides the only effective means of

¹For detailed information see official publications: U. S. Dept. of Commerce Bulletin 82, "Imports of Chemicals in 1914"; U. S. Tariff Commission, Tariff Information Surveys on "Sodium Compounds"; and U. S. Geological Survey Bulletins "Sodium and Sodium Salts."

overcoming pests harmful to the crop, so that it is to be expected that the benefits arising from fumigation will also become recognized by the citrus-growing areas of the South American states, especially since a moist climate is more conducive to the growth of pests and fungi.

About 500 tons of NaCN is consumed annually by the Department of Agriculture in fumigating freight cars at the Mexican border to keep out the pink boll weevil.

Case-hardening and electroplating annually require considerable quantities of cyanides. In the latter industry it is not unlikely that the electroplating of sheet iron will to a great extent displace galvanizing by hot dipping. The developments of the electrolytic zinc industry permit the use of the commercial article in new ways, and considerable investigation is now being conducted on the electrodeposition of zinc from sodium-zinc cyanide solutions. The coating thus obtained has a greater protective action against rusting than one from sulphate solutions.¹

Under favorable conditions regarding cost of production, sodium cyanide might be considered as one means for conducting the synthesis of indigo. As it is, however, only relatively small quantities are used in the manufacture of dyes and synthetic organic chemicals.

REPLACEMENT OF SODIUM CYANIDE BY HYDROCYANIC ACID

Hydrocyanic acid gas has already displaced the solid salt used in the old "pot method" of fumigation. This method was both dangerous and inefficient, and recently Harker² has shown that only about one-third of the HCN of the salt is liberated when sodium cyanide and sulphuric acid react on each other under ordinary conditions. The other two-thirds is therefore lost for fumigating purposes.

The use of hydrocyanic acid gas is now firmly established in California. The gas is generated in stations close to the fruit-growing areas, so that should the gas from coke ovens be used it would have to be transported over longer distances. Although certain restrictions are placed on the transportation of this gas, they are not sufficient to offset the advantages of having the cyanide in the most concentrated form possible, as 1 lb. of the gas is equal to at least 2 lb. or as much as 4 lb. of the less pure commercial salt. It cannot be denied that in the handling of hydrocyanic acid there is a certain amount of danger, but the few accidents resulting from the handling of such large quantities of the gas in California attest its comparative safety when due precautions are taken. Compressed in cylinders, it is probably as safe as any other toxic gas.

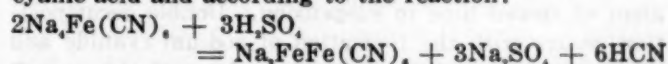
Apparently there is no reason why the use of hydrocyanic acid gas should not be extended, and made to replace sodium cyanide in other uses; provided it is possible to produce the cyanide more economically in the form of the gas. Thus in ore treating, calcium cyanide might be prepared easily and cheaply at the mines by passing a weighed amount of HCN gas from cylinders into a tank of water containing a slight excess of lime in solution. Calcium cyanide is readily formed and is quite stable in the dilutions employed for extracting gold and silver from ores. In some instances it might be necessary to add a corresponding amount of soda ash to form the sodium compound. This then would be pro-

duced without first obtaining the solid salt, thus saving the evaporation and other costs in preparing the ordinary commercial product.

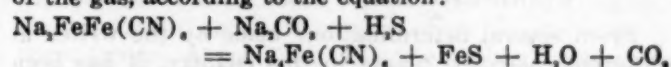
In a like manner the preparation and purification of cyanide electrolytic solutions by means of a zinc salt and hydrocyanic acid gas, lime and soda ash instead of sodium cyanide is also suggested. The preparation of zinc cyanide could proceed from calcium cyanide as favorably as from sodium cyanide. When the latter salt only is desired, the double reaction between HCN, lime and soda ash would be resorted to. It could also be applied for rejuvenating cyanide solutions which have become impoverished in cyanide by the absorption of CO₂. In this instance, of course, no soda ash would be required; the calcium cyanide would be added direct, and the purified solution returned to the cells after filtering off the calcium carbonate, which is easily washed.

DESCRIPTION OF ESPENHAHN PROCESS

The process previously referred to for the direct recovery of cyanogen compounds from coke-oven gas has been described in the British patent 109,254 (1916), in U. S. patent 15,090 (1921 reissue) and in a number of foreign patents. It is designed to operate in conjunction with direct and semi-direct methods of ammonia recovery. Briefly, the washing solution consists of a strong solution of an alkali, such as soda ash, in which is suspended an iron compound, such as ferrous sulphide or sodium ferrous-ferrocyanide, which is capable with combining with the HCN of the gas. The iron compound is not withdrawn from the cycle of operations, the only chemicals added being soda ash, sulphuric acid and lime. The solution with the iron precipitate in suspension is circulated from tanks over vertical centrifugal washers, through which the gases pass, preferably after having been previously freed of their ammonia. These washers are very efficient in operation, as they bring the gas into intimate contact with the solution without offering large back pressure, require little power and take up only a small space. The hydrocyanic acid present in the gas is absorbed practically quantitatively as sodium ferrocyanide; and no side reactions occur, such as the formation of sulphocyanides. When the solution in the first washing tank has become charged with sodium ferrocyanide—about 75 per cent conversion—it is filtered through leaf filters suspended in the tank. The solubilities of the two salts in solution, sodium carbonate and ferrocyanide, are such that on being cooled after its withdrawal only the latter salt is precipitated. The crystals of ferrocyanide are then centrifuged before being transferred to a still, in which they are heated with the theoretical amount of sulphuric acid to drive off half the hydrocyanic acid and according to the reaction:



The precipitate of sodium ferrous-ferrocyanide is washed free from sodium sulphate and transferred to the last washing tank containing the highest percentage of soda ash, from which it is circulated in countercurrent system, meeting the gas in the vertical washers. Here the precipitate is first converted into soluble ferrocyanide and ferrous sulphide by the hydrogen sulphide of the gas, according to the equation:



The solution of ferrocyanide with the excess soda ash

¹C. J. Wernlund, *Trans., Am. Electrochem. Soc.*, 1921, pp. 346-366.

²*J. Soc. Chem. Ind.*, 1921, pp. 182-185.

finds its way to the last tank, and by being pumped over the first washer becomes enriched in soluble ferrocyanide until it is withdrawn. The solution containing the most soda ash and FeS absorbs the last of the HCN from the gases in the last washer. This washer is divided into two sections, in the upper one of which the FeS precipitate is prepared by circulating a solution of iron sulphate to which ammonia has been added. The section is used for this purpose only when a fresh supply of FeS is required, as for instance when ferrocyanide is withdrawn from the system. At other times the whole washer is devoted to the extraction of cyanide. The description is made clearer by the accompanying flow sheet shown in Fig. 1.

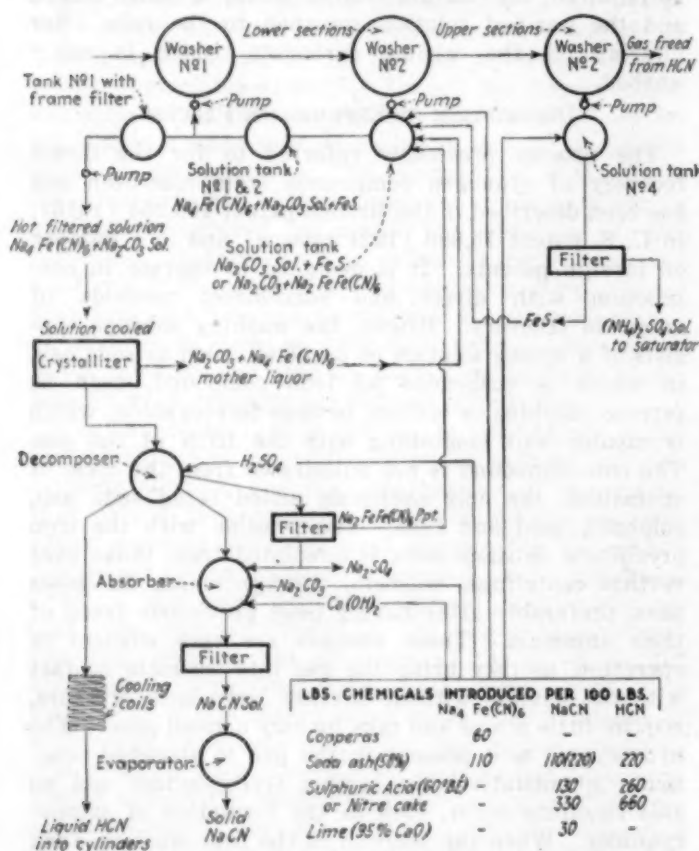


FIG. 1—FLOW SHEET OF PROCESS FOR THE DIRECT RECOVERY OF CYANOGEN PRODUCTS FROM COKE-OVEN GAS

As will be discussed later, the process promises to render the recovery of HCN possible in a very economical manner. If sodium cyanide is desired, it is preferable, owing to the high cost of caustic soda, to proceed with its preparation by absorbing the HCN in a solution of sodium sulphate or carbonate containing an equivalent of slaked lime in suspension. Double decomposition occurs with the formation of sodium cyanide and the precipitation of the lime in the form of the sodium salt employed. If sodium sulphate is used for this purpose, the process is rendered still more cyclic, since less soda ash and sulphuric acid are introduced into the scrubbing process, although in this instance the sodium cyanide recovered will not be as pure as when soda ash is used.

CYANIDE AVAILABLE FROM COKE OVENS

From several determinations made by the writer at different coke-oven plants in this country, it has been found that the gases contain on an average—the fluctu-

ations are very slight—70 to 75 grains of HCN per 100 cu.ft., so that there is available from a ton of average coking coal at least 1 lb. of hydrocyanic acid or 1.75 lb. of sodium cyanide. Compared with the original quantity of coal charged into the ovens, or even with the yield of tar or ammonium sulphate, this amount at first sight may not appear considerable; but in the aggregate the quantities are more impressive. Thus at a coke-oven installation of moderate capacity carbonizing 2,000 tons of coal a day, there may be recovered 600 tons of sodium cyanide a year. Reviewing the byproducts statistics of this country, it will be seen that the quantity of cyanide now going to waste is considerable, and annually amounts to a tonnage represented by five figures.

Assuming a normal recovery of 1.75 lb. of sodium cyanide per ton of good coking coal, the estimated yield if direct recovery plants were introduced at all works in the near future may be considered to be between 25,000 and 27,000 tons of NaCN. The economical production by a direct process is, however, lower than appears from these figures. It will not be profitable in many instances for units of smaller sizes to install such a process, unless they are favorably situated near points of consumption, such as gold and silver mining centers. Hence the economical capacity of all ovens may be considered to be at most about 20,000 tons per annum.

It might be economical for such plants, however, to introduce recovery of ferrocyanide, as installation and operating costs are considerably lower when producing this compound only. It is also possible to centralize half of the cyclic process, whereby the ferrocyanide from one or more units is converted into hydrocyanic acid or sodium cyanide at a single plant centrally situated. By this means a considerable saving is obtained in operating and installation costs. This method of operation would appear advantageous in Great Britain, where byproduct plants are grouped in different localities, in any one of which the plants are relatively close together. The transportation of ferrocyanide to the central plant would thus not be attended with high freight costs, such as might be the case in the United States.

It is true that some plants have already introduced cyanide recovery, but with these few sodium ferrocyanide is generally the finished product. This is produced in a manner similar to European practice, by first forming a complex ammonium ferrocyanide, which is converted into sodium ferrocyanide at a separate stage after the washing process. The quantity thus produced, however, is very small and in value is negligible compared with any of the other byproducts. At such plants the ammonia of the gas is recovered by indirect methods. Few of the operators using direct recovery, certainly none at the larger units, have attached any importance to the cyanide in their gas, or at least they have not looked upon its recovery as economical.

COST OF RECOVERY

It is not intended in this paper to present an analysis of the costs of production. With rapid changes in prices of chemicals and materials as well as in labor and construction costs, such a presentation would require too frequent revision to be of much service. It is considered more suitable to make only general comparisons between the pre-war price of sodium cyanide (96 to 98 per cent), which was 15c. a lb., and the estimated cost of production under high post-war conditions, such as existed at

the beginning of 1921. The cost of manufacturing sodium cyanide and hydrocyanic acid from coke-oven gases by the process described in this paper is compared with the cost of producing hydrocyanic acid from synthetic cyanide in the following table:

	Price Per Lb. NaCN	Estimated Cost Per Lb. HCN
By synthetic process (in 1913) ..	15c.	30-33c.
By synthetic process (in 1921) ..	20-24c.	37-52c.
By Espenhahn process (in 1921) ..	4.5-9.0c.	9-13.5c.
HCN as NaCN, per lb. (in 1921) ..	4.0-5.0c.

From such figures the production of sodium cyanide from coke-oven gases appears decidedly advantageous, but they are still crude estimates, based on a process which has not yet reached a semi-commercial scale.

When coke ovens are considered as a source of HCN instead of NaCN, the comparison is still more favorable to the direct process, especially since, as has already been pointed out, the gas is able to replace the solid salt with advantage in many instances. With synthetic processes it is first necessary to produce sodium salt before being able to proceed with the preparation of the gas; while with a direct recovery process from coke-oven gases the reverse holds true. This means that in the latter process considerably less labor and plant expenditure is required for the recovery of HCN than for NaCN; indeed it is approximately two-thirds. In other words, conditions are more favorable for the production of HCN as a byproduct direct than from an alkali salt, from which it must be liberated, such as is necessary in all synthetic processes now in operation.

Recent Researches on Static Notched Bar Testing

BY HERMAN A. HOLZ

THE notched bar test is not necessarily an impact test. In fact, the static method of investigating notch brittleness as carried out on the Humfrey machine¹ possesses a number of important advantages:

In the single blow impact test one single figure only is obtained, representing the total energy expended in breaking the specimen plus an unknown and variable amount in friction, vibrations and noise, but no information is available as to the values of the various factors of which this figure is the integral. On the other hand in a static test the forces applied are under perfect control and can be measured with great precision. In breaking a notched specimen in a static testing machine,

the angle to which the test piece is bent and the resistance which it offers to the external bending moment are known at each stage of the test. A complete and continuous autographic diagram of the bending-angle bending-moment may be therefore obtained, while the total force expended in fracture may be indicated by an automatic integrator.

Researches on the influence of variations in temperature, depth of notch or radius of notch can be conveniently carried out on the static machine, and a number of check tests can be made on adjoining sections of each specimen.

The curves shown herewith are results of recent experiments undertaken by J. C. W. Humfrey, the British metallurgist who designed the static notched bar testing machine carrying his name.

Fig. 1 shows a number of typical Humfrey curves, the standard specimens being 10 mm. square, with a V-notch 2 mm. deep, angle 45 degrees, radius at bottom $\frac{1}{4}$ mm. (the standard Izod specimen). As will be seen, tough Ni:Cr steel gave the highest value, both in the maximum strength of the specimen—i.e., the resistance

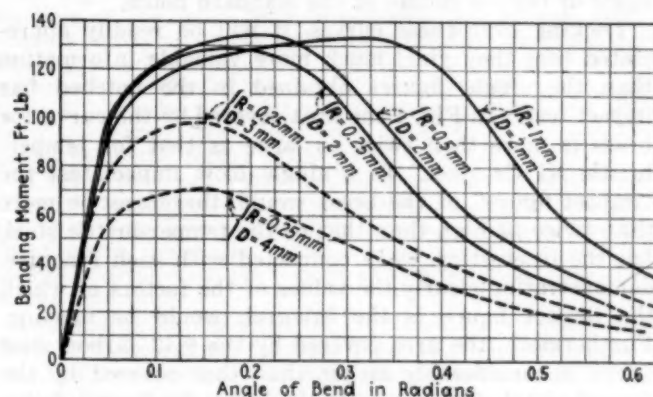


FIG. 2—EFFECT OF VARIATIONS OF RADIUS AT BOTTOM OF NOTCH AND DEPTH OF NOTCH IN TOUGH Ni:Cr STEEL

to slow bending until the metal back of the notch gave way, and also in the resistance of the material to propagate the crack after initial fracture had once set in. The curve for "temper brittle Ni:Cr steel" runs parallel to that of the same material in tough state, showing a similar resistance to static bend, but shortly before the maximum bending was obtained in the correctly heat-treated material, the temper brittle steel fractures, the fracture running at once across the entire cross-section of the specimen, no resistance whatever being offered to the propagation of the crack after it was once started. The curve for "nickel steel forging" also shows strength and toughness. The next three curves (0.35 carbon steel forging; 0.42 carbon steel normalized, and dead mild steel) are of considerable interest. While the two first-named steels run fairly parallel through a considerable portion of the bending operation, the forged material being slightly stronger in that regard, the normalized steel (0.42 C) is more ductile, the forged specimen breaking clear off at its maximum bend. The "dead mild steel" shows, of course, lower strength but high ductility. The "soft brass" showed the highest ductility, reaching the maximum bending angle at more than twice that of tough Ni:Cr steel (0.425 radians against 0.2 radians). It is very interesting to notice in these typical curves that the plain carbon steels show irregularities in the initial portions of the curves, while

¹CHEM. & MET. ENG., VOL. 23, p. 1180, Dec. 15, 1920.

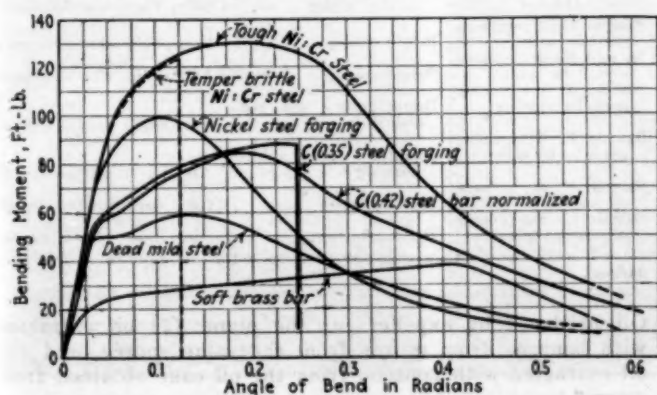


FIG. 1—TYPICAL DIAGRAMS OF VARIOUS ALLOYS, USING THE STANDARD IZOD SPECIMEN

these do not appear in any of the other alloys investigated. It seems that these irregularities are due to the identical molecular disturbances in these steels which produce the "drop of the beam" in the tensile test.

Fig. 2 shows the effect of variations of radius at bottom of notch in tough Ni:Cr steel. Radii of 0.25 mm., 0.5 mm. and 1 mm. were investigated and the well-known law was confirmed that notched material breaks easier with a sharper notch, on account of the increased concentration of force. In the latter case the curves are almost identical, fracture with $\frac{1}{2}$ mm. radius occurring as shown in Fig. 1; $\frac{1}{2}$ mm. increasing the bending moment at sudden fracture to 125 ft.-lb. and deflection of 0.225 radians. Radius of 1 mm. slightly increases the bending moment, but fracture is resisted until the specimen bends through an angle equal to 0.335 radians (19 deg.). Much the same variations were observed in temper-brittle Ni:Cr steel.

Fig. 2 also demonstrates the effect of variations in the depth of notch; notches of 2 mm., 3 mm. and 4 mm. depth were investigated, the specimen cross-section remaining 10 mm. square, with no variations in the angle or bottom radius of the standard notch.

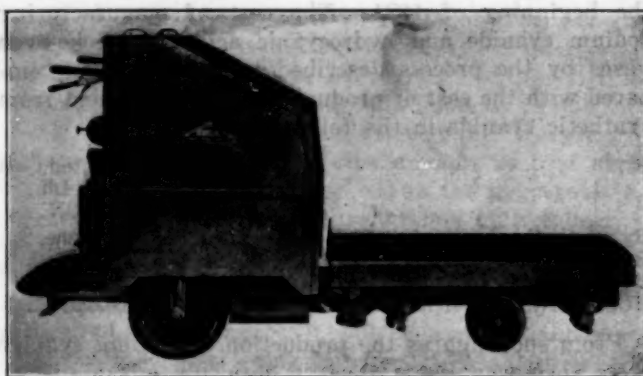
Looking over these curves, it will be readily appreciated that they yield much more valuable information than the single figures obtained in the notched bar impact test. In Fig. 1 the area covered by the curve for brass is more than twice as large as that for temper-brittle Ni:Cr steel. In a single blow impact test the "impact figure" of the brass would, therefore, be more than twice as high than that of the temper-brittle steel, but the interesting story connected with each fracture, demonstrating clearly the values of the factors of which the impact figure is the integral, would be missing. Furthermore, the area covered by the 0.42 carbon steel curve is considerably larger than that covered by the forged nickel steel curve; in this case, the impact figure would have been higher for the 0.42 carbon steel. On the other hand, the forged nickel steel is undoubtedly the stronger of the two materials, possessing a higher resistance against initial fracture at the notch. This point would not be brought out in the impact test, but is clearly shown in the Humfrey diagram. In the construction of machinery it may be preferable in some cases to utilize material of high resistance to initial notch fracture, while in other cases a steel will be found safer which offers a higher resistance to propagation of a crack.

Research work along similar lines will be of great practical value in the metallurgy and heat-treatment of ferrous and non-ferrous alloys. One subject still to be investigated is the reason for the very large increase in notch brittleness of steel at the lower range of atmospheric temperatures (from 0 deg. C. down to -30 deg. C.), resulting in failures of railroad material in winter and of aviation material in high altitudes. Such research work on low temperatures can be conveniently carried out by means of the Humfrey apparatus.

New Gasoline-Powered Lift Truck

The Clark Tractor Co., of Buchanan, Mich., has placed on the market a gasoline-powered elevating platform truck. This truck is shown in the accompanying illustration. It will be noticed that it conforms in appearance to the electric lift trucks which have been in use for some years past.

The truck has a loading platform 26 x 54 in. which



GASOLINE-POWERED ELEVATING PLATFORM TRUCK

will elevate a load of 4,000 lb. from a minimum of 11 in. to a maximum of 16 in. above the floor in 8 seconds. This lift can be stopped by a hand control lever at any point. There are automatic stops for both upper and lower limits. The lifting mechanism is operated by hydraulic pressure.

The power plant consists of a 15-hp. four-cylinder tractor engine of 3 $\frac{1}{2}$ -in. bore and 4 $\frac{1}{2}$ -in. stroke. Engine, transmission, governor, fuel tank and radiator are mounted together in a closed compartment. The drive is through a bevel geared axle. The design of all the parts is such that any good automobile mechanic can do all necessary maintenance.

The advantage of this machine lies in the use of a gasoline power plant. This permits continuous operation without the stops for changing battery necessary where storage batteries are used. Full power is available at all times. For plants located so that a charging station cannot be conveniently installed, the application of this truck should solve many difficulties.

Synopsis of Recent Chemical & Metallurgical Literature

Comparison of Expelled and Extracted Corn Oils.*—Comparison is made of the general characters and quality of three types of corn oil which have been prepared from the same general lot of material so as to make their source comparable. The three types are as follows: (1)

TABLE I—COLOR AND APPEARANCE OF CRUDE CORN OIL IN STANDARD $\frac{1}{2}$ -INCH BOTTLES AFTER STANDING IN THE DARK FOR ONE MONTH

Oils (a)	Color	Clarity, Deposit of Solids, etc.
Sample D, dry-process germ by expeller . . .	Bright golden	Very slight whitish deposit
Sample E, dry-process germ by solvent	Bright golden	About $\frac{1}{2}$ -in. whitish deposit
Sample A, wet-process germ by expeller	Bright golden, with reddish tinge	Very slight whitish deposit
Sample B, wet-process germ by solvent	Slightly more reddish than oil A	About $\frac{1}{2}$ -in. whitish deposit
Sample F, dry-process oil cake by solvent . . .	Reddish yellow	$\frac{1}{2}$ -in. dark brown deposit
Sample C, wet-process oil cake by solvent . . .	Reddish brown	$\frac{1}{2}$ -in. light brown deposit

(a) The samples of oil are arranged according to their depth of color, lightest to darkest.

Oil produced by expellers at the plant, (2) oil extracted with benzene from germs from the same source, and (3) oil extracted with benzene from the oil cake obtained from

*Abstract of Bulletin 1054, by A. F. Sievers, issued by the Department of Agriculture, Bureau of Plant Industry, March 11, 1922.

TABLE II—COMPARISON OF SOME PHYSICAL AND CHEMICAL CONSTANTS OF THE FINISHED CORN OILS

Oils	Sp. Gr. At 25 Deg. C.	Index of Refraction At 25 Deg. C.	Iodine Number (Hanus)	Acid Number	Saponi- fication Number	Acetyl Number	Insoluble Hehner Number	Acids		Reichert- Meisel Number	Solidifying Point of the Mixed Acids, Deg. C.
								Liquid Per Cent	Solid Per Cent		
Sample A....	0.9181	1.4723	122.8	0.078	191.7	9.26	95.07	91.27	9.73	0.352	16.6
Sample B....	.9186	1.4726	121.6	.10	189.6	9.81	95.04	91.10	9.90	.312	16.8
Sample C....	.9185	1.4733	123.0	.116	183.0	10.93	92.60	89.96	10.04	.378	16.5
Sample D....	.9177	1.4726	124.8	.066	187.2	7.26	95.06	89.82	10.18	.115	16.0
Sample E....	.9165	1.4732	121.2	.106	194.2	9.99	93.00	89.88	10.12	.190	16.3
Sample F....	.9179	1.4731	125.5	.123	197.5	10.58	92.40	89.61	10.39	.135	16.5

the first-mentioned process. These oils were neutralized, bleached and deodorized, their physical and chemical constants determined, and their color, odor and taste compared. Such a comparison should show whether there is a possibility of preparing corn oil by benzene extraction that will be equal to that produced by the expeller method.

Samples of the two expeller oils and the four benzene-extracted oils were placed in standard 54-in. bottles for the purpose of comparing the color and other characteristics. Some of the oils, especially the benzene-extracted oils from the oil cake, appeared to be somewhat turbid when cold, although they were filtered clear while warm. For this reason the samples were permitted to stand in a dark place for a month and their condition then noted. Table I summarizes the appearance of the oils.

Of the crude oils those extracted from the cake were the darkest and deposited the greatest amount of sediment on standing. The benzene-extracted oils from the wet-process germs contained more free acids than the oils obtained by that method from the dry-process germs, this being especially true of the oils from the cake. All the oils were refined in the same manner, with the exception of the benzene-extracted oil from the dry-process germ cake. Owing to the sediment present, this oil required a greater quantity of caustic. The oils were all deodorized by blowing them with a current of steam at 225 deg. C. (437 deg. F.) for 2 hours under a vacuum of 25 in. This treatment removes odorous volatile constituents and in the case of solvent-extracted oils tends to remove the final traces of the solvent.

The expeller oils showed the lowest loss on treatment with caustic; in the oils obtained by benzene extraction from the germs the loss was somewhat greater, and the benzene-extracted oils from the oil cakes showed by far the greatest loss.

In order to show whether the six oils under discussion differed to any extent as regards the usual physical and

chemical constants, these constants were determined and the results summarized in Table II.

In so far as is indicated by the physical and chemical constants, these six oils do not appear to differ to any great extent. Such differences as exist are not any greater than would be expected in several samples of normal oil. Neither do the constants of these oils on the whole show any considerable divergence from those reported by other observers.

No material difference could be noted in the finished oils from the germs immediately after their preparation, but upon standing, some deterioration took place, and this was somewhat more noticeable in the benzene-extracted oils than in the expeller oils.

All the oils except perhaps that obtained by benzene extraction of the cake from wet-process germs were sufficiently light in color to make them suitable for salad and cooking purposes.

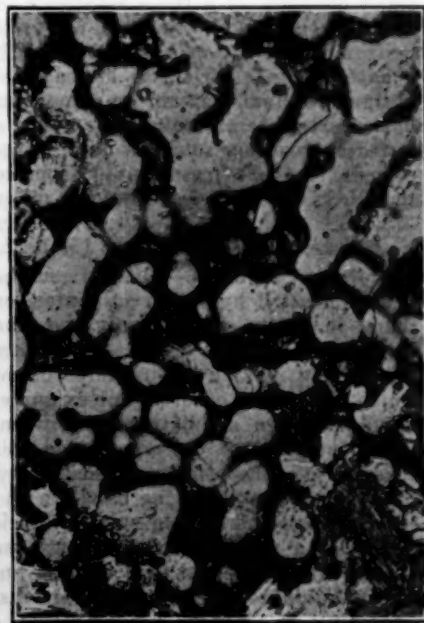
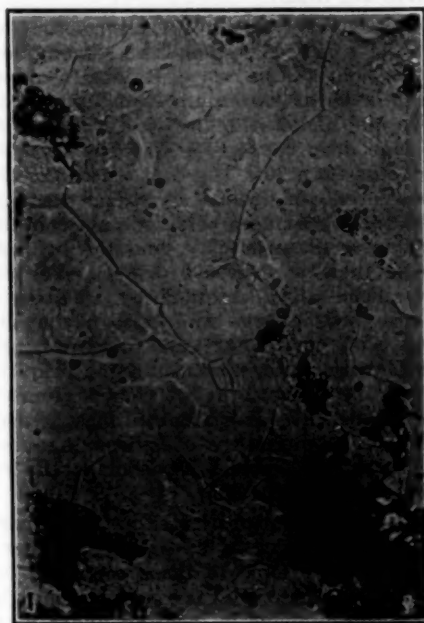
The oils obtained by benzene extraction from the two types of oil cake were inferior in all respects to the oils from the germs, that from the cake from wet-process germs being the poorer of the two.

A more thorough deodorization than that to which the oils could be subjected in these experiments might eliminate the remaining traces of either benzene or other odorous constituents, which no doubt account for the slight inferiority noticed in the benzene-extracted oils from the germs.

Phosphorus in Open-Hearth Steels.—Several years ago Dr. J. S. Unger, of the Carnegie Steel Co., prepared a series of 0.12 C basic and acid open-hearth steels, to which P was added while being cast, thus giving a series of ingots containing phosphorus in varying amounts from 0.008 to 0.115 per cent.¹ E. C. Groesbeck, of the Bureau of Standards, made some studies on small samples of these steels.² Samples of each were heated to 900 deg. C., held for about

¹Proceedings, American Iron and Steel Institute, 1918, p. 172.

²Technologic Paper 203.



FIGS. 1 TO 3—CELLULAR STRUCTURE IN MEDIUM STEEL WITH 0.42 PER CENT P. $\times 500$

Fig. 1—Etched with 5 per cent picric acid in alcohol.

Fig. 2—Same as Fig. 2, slightly out of focus.

Fig. 3—Same area etched with Stead's reagent.

15 minutes and cooled at a rate which carried them from 750 to 600 deg. C. in 4 hours, 2 hours, 1 hour, 30 minutes, 15 minutes, and 5 minutes respectively. There resulted a marked irregularity in the distribution and size of ferrite grains and pearlite kernels which cannot be ascribed to P content or method of manufacture. The grain size is roughly proportional to the time the sample remained above A₁, which represented the time available for growth of austenite grains. As the cooling rate increased, the relative number of pearlite kernels as compared to ferrite grains also increased, in conformity to the decreased opportunity for coalescence. No relation between P and amount of spheroidized cementite could be discovered. Brinell hardness (500 kg. load) appeared to increase consistently from 64 ($P = 0.03$) to 70 ($P = 0.11$), with a variation of ± 3 , depending upon the rate of cooling.

In general the distribution of pearlite was very irregular; many times a large ferrite streak, shown to be high in phosphorus, contained along its rib a series of non-metallic inclusions. Groesbeck thinks this indicates that P segregates at the edges of the ingot crystals (dendrites), expelling therefrom the excess carbon which would also be expected to remain there. Normal picric or nitric acid etching often shows a shadowy cellular structure in the ferrite (Fig. 1) which is intensified if the field is a little out of focus (Fig. 2), a characteristic of very slight irregularities in a plane surface. Etching with Stead's reagent (Fig. 3) shows this cellular structure to be made up of regions high in P (light) and low in P (dark), a structure independent of the lines marking abutting ferrite grains. Such structures were developed in basic steels containing 0.05 P and more, and in the acid steels containing 0.03 P and more. Whiteley¹ has already studied the mutual distribution of C and P at various temperatures, and the present paper supports Whiteley's findings.

Recent Chemical & Metallurgical Patents

British Patents

For complete specifications of any British patent apply to the Superintendent, British Patent Office, Southampton Buildings, Chancery Lane, London, England.

Pigments.—In processes for the preparation of oil pigment pastes from water pastes by grinding in the presence of a small quantity of a third substance or "activator," the following compounds are used as "activators": the oxides, hydroxide, acetate or basic acetate of lead, the borate, carbonate or basic carbonate of lead, cobalt, aluminum, magnesium, calcium, barium or strontium, or the carbonate or basic carbonate of manganese. The activator may be produced by reacting solutions in presence of the pigment. The pigment may be precipitated from colloidal suspension by the addition of an electrolytic or other coagulant. (Br. Pat. 173,350. Cookson & Co., Ltd., Newcastle-on-Tyne, and H. E. Clarke, Gateshead. Feb. 15, 1922.)

Dialkyl Sulphates.—Dialkyl sulphates are obtained by distilling alkyl hydrogen sulphates, or mixtures containing them, in vacuo so that only the small portion of liquid actually undergoing distillation is heated and so that the vapors and residue are rapidly removed from the point at which distillation occurs. For example, the liquid containing alkyl hydrogen sulphate may flow in a thin film over a heated surface, or down a heated coil or tube, or may be sprayed into the still or carried into the heated zone by a revolving drum or moving band. In an example a mixture of ethyl alcohol and fuming sulphuric acid is caused to flow by means of a revolving orifice down the inside of a vertical heated tube connected to a vacuum and condensing system; diethyl sulphate separates from the distillate, the remainder, consisting of alcohol, sulphuric acid, etc., being utilized in the next operation. Dimethyl, dipropyl and dibutyl sulphates

may be similarly prepared. (Br. Pat. 175,077. British Cellulose Chemical Manufacturing Co., London, April 5, 1922.)

Phosphate Fertilizer.—Soluble phosphates are obtained by acting on a mixture of crude phosphate and alkaline sulphate with hydrochloric acid gas in presence of water. The addition of water may be effected by incorporating with the mixture loosening substances such as infusorial earth which can absorb moisture and still remain powdery. The required moisture may be added either before or after admixture with the crude phosphate and alkaline sulphate. The reaction is preferably carried out in stationary cylinders having stirring shafts, the mixture advancing slowly in the cylinder against a current of hydrochloric acid gas. (Br. Pat. 174,370. Not yet accepted. Rhenania Verein Chemischer Fabriken Akt. Ges. Zweigniederlassung Mannheim, Mannheim. March 22, 1922.)

Barium Hydrate.—In the production of barium hydrate from barium carbonate by forming barium silicate and decomposing this with water as described in specification 110,537, the proportion of silica to barium carbonate is such as to give a silicate of the formula $\text{SiO}_2 \cdot 3\text{BaO}$ or a silicate intermediate between this and $\text{SiO}_2 \cdot 2\text{BaO}$. The formation of the silicate from silica and barium carbonate or monobarium silicate and barium carbonate is effected in a rotary or tunnel furnace at 1,300 to 1,500 deg. C. The tribarium silicate or the intermediate silicate is treated with water to obtain barium hydrate and monobarium silicate, which is used for the next charge to be heated, and so on continuously. (Br. Pat. 174,052. Not yet accepted. C. Deguide, Enghien, France. March 8, 1922.)

Alkali Silicates.—Alkali silicates are obtained by treating barium silicates of the composition $\text{SiO}_2 \cdot 1-3\text{BaO}$ with water and alkali carbonate or sulphate. Barium carbonate or sulphate is separated and may be converted into silicate by heating to 1,300 to 1,500 deg. C. with silica or silica and carbon. If the barium silicate is too basic, it may be treated with water to remove some barium as barium hydrate, leaving monobarium silicate. The sodium silicate obtained, containing some hydrate if basic barium silicates were used, may be caustified by lime. (Br. Pat. 174,581. Not yet accepted. C. Deguide, Enghien, France, March 22, 1922.)

Fatty Acids.—For the production of fatty acids, liquid hydrocarbons, such as the distillation products of rock oil or petroleum, are first treated with liquid sulphur dioxide for a sufficient length of time to remove all unsaturated impurities and an oxygen-containing gas is then blown through the unattacked residue, preferably in the presence of a base such as lime. (Br. Pat. 174,611. Not yet accepted. E. Zerner, Vienna. March 29, 1922.)

Metals and Alloys.—In an electric furnace method of making metals and alloys low in carbon and silicon from materials which are high in silicon and contain also oxides of one or more metals such as chromium, vanadium, manganese, tungsten, iron and nickel, the electric furnace is so worked that the voltage drop between a movable electrode and the charge is not less than 70. The constituents of the charge are finely powdered and intimately mixed and are preferably briquetted, the binder used being one not containing carbon, such as water glass or clay, and the briquets being dried by heating them to over 500 deg. C. For example a manganese-silicon alloy obtained by smelting a mixture of manganese ore, quartz and carbon may be powdered and mixed with manganese and dolomite, and the mixture briquetted with water glass, and the briquets, after being dried, may be reduced in an electric furnace operated as described above. The slag obtained may be used as raw material for the manufacture of silicomanganese. (Br. Pat. 174,618. Not yet accepted. Aktiebolaget Ferrolegeringar, Stockholm. March 29, 1922.)

Hydroxy-Quinones.—A chlorine-substituted anthraquinone is treated with a base in presence of an oxidizing agent, whereby a hydroxy group additional to those replacing the chlorine atoms is introduced. Alizarin, for instance, may be obtained from 2-chloranthraquinone by heating under pressure with caustic soda, sodium nitrate or chlorate, and water, the mixture being stirred. (Br. Pat. 174,101. A. H. Davies and Scottish Dyes, Ltd., Carlisle. March 8, 1922.)

¹British Iron and Steel Inst., vol. 101, p. 363 (1920 I), and CHEM. & MET. ENG., vol. 23, p. 986, Nov. 17, 1920.

Book Reviews

ANALYSIS OF FUEL, GAS, WATER AND LUBRICANTS.

By S. W. Parr, University of Illinois. International Chemical Series. Third Edition. New York: McGraw-Hill Book Co., Inc. 250 pp. Price \$2.50.

This book in its third edition has been expanded somewhat to make it quite a comprehensive text book for students in chemical engineering and mechanical engineering. It is an admirable admixture of text for study and outline of laboratory procedure to guide the experimental work of the student. It is also very suggestive of lecture demonstrations which would be effective in presenting before classes the important points of fuel problems. However, it has not been in any way laid out as a lecture guide and it is only indirectly that it serves this latter purpose.

In many particulars the book has been brought well up to date, including in some cases data and references for 1920 and 1921. However, in other sections, notably the one on petroleum, the data are still those of 1918. This is unfortunate for any volume appearing in 1922, since data for 1921 are already available.

In general the work has not been prepared for chemists, but rather for engineers. Moreover, it is clearly intended as a text and not a reference work. Bearing these two points in mind, one need have no hesitation in looking upon the revised work as a valuable addition to our technological literature.

R. S. McBRIDE.

METRIC SYSTEM FOR ENGINEERS. By Charles B.

Clapham, lecturer in the engineering department, University of London. 182 pp. New York: E. P. Dutton & Co. Price, \$6.

The author states that "actual use of the metric system in the engineering industry in Great Britain has been steadily increasing, receiving much impulse during the recent war." There is a similar increase in this country, therefore a book of this sort will be very helpful to all who use the metric system in engineering calculation or measurement. The author is probably correct in stating that in the teaching of the metric system in the schools it is regarded as an alien subject to which a minimum of time need be given.

The author gives complete metric and English tables with the *exact* equivalents, but he also gives in each case the practical units and the *practical* equivalents, with rules and conversion charts for converting one into the other. There are many practical rules like the following which one would look far to find: "A weight in pounds is converted into kilograms by subtracting from it one-tenth of its own value and dividing the remainder by 2," error 0.3 per cent; and "a length in meters may be converted into yards by adding to it one-tenth of its own value," error 0.3 per cent.

Special attention is given to the use of measuring tools of the drafting room and workshop which may be graduated in metric units—e.g., verniers, micrometers and planimeters. Examples in connection with screw cutting and gear wheels are dealt with at length. The author points out a fact which will be a surprise to the uninitiated, that "all metric screws likely to be required can be cut on the usual English and American lathes, well within the accuracy required for manufacturing purposes, if one additional change wheel be provided" (p. 33). This arises from the fact that 1 in. equals very exactly 2.54 cm., hence it is necessary to have a wheel with 127 teeth, in addition to the wheels already in use.

Factors are given for the conversion of compound measures, such as British thermal units, horsepower, etc., also comparative tables of common engineering data, such as tensile strength and elastic moduli. A discussion of the C.G.S. system is also given, so that while the book is helpful to readers whose knowledge of mensuration is rudimentary, it is not without interest to the advanced student.

The author tries to take an unbiased position in regard

to the compulsory adoption of the metric system in Great Britain and the United States, stating that this subject "is one upon which an isolated individual opinion would be of little value." He has, however, approached the subject from a constructive point of view and has done a piece of work which is essential to the transition to the metric system. His "brief survey of the controversy" is invaluable, since it throws much light (without heat) on the problem of the introduction of the metric system into industry from the standpoint of the engineer. He repudiates the idea fostered by the opponents of the metric system that the adoption of metric units in metric countries is far from complete. He says "the use of such units [as the *son* in France] is confined almost entirely to speech, and all written measurements and data appear in the official units." "At the present time the metric system is the only legal system of measurement in all the foremost countries of the world with the exception of the British Empire and the United States" (p. 143). In the newer and lighter branches of industrial work the metric system is met with to a considerable and ever increasing extent as regards lengths for manufacturing purposes. With some firms and some particular sections it is the only system employed (p. 143), and he gives a list of such types of firms. "In purely scientific work the metric system is alone used" (p. 144). "The English-speaking nations are the only non-metric ones of importance, and other nations cannot be expected to revert from metric to the Imperial system" (p. 146). "The real importance of the non-compliance of Britain and America with the international system is that rapidly developing countries using the metric units may be better catered for by the metric nations of Europe" (p. 146). In regard to the cost of the change, which is the great argument of the opponents of the metric system, he says, "It is to be feared that many false objections have been put forward" (p. 148). An authoritative statement of this character from an engineer who has made an unbiased study of the calculations, etc., involved in the change is very gratifying to the chemist who longs for the day when our cumbersome system can be entirely abandoned without hardship.

EUGENE C. BINGHAM.

STUDY QUESTIONS IN ORGANIC CHEMISTRY. By Alexander Lowry and Thomas B. Downey. 92 pp. New York: D. Van Nostrand Co. Price \$1.

The authors have put in pamphlet form a series of classified questions which are to serve as a guide and outline in the study of elementary organic chemistry. In addition they have appended a rather complete list of the more common reference books on the various phases of the subject.

This method of focusing attention on the subject has always proved valuable, in the experience of the reviewer, in teaching organic chemistry. The idea of using the same set of questions repeatedly, however, is open to criticism.

First, experience shows that when no changes are made in questions from time to time, completely answered sets are generally passed down from one class to the succeeding class. This practice, of course, defeats the very purpose of the questions. Second, due to wide variations in classes from year to year and to differences in presentation, the emphasis on the various topics has to be shifted. To meet this situation, it becomes necessary to frame new or at least different types of questions.

The material covered by the questions is fairly wide in scope. There are, however, certain omissions from the subject of optical activity—particularly optical resolution, symmetric synthesis, *muta*-rotation and the Walden inversion. It would seem that a separate section devoted to this subject would be better than the isolated questions scattered throughout the pamphlet. Except for the omissions just noted, the questions can be recommended as complete and satisfactory.

The pamphlet should prove particularly useful to those outside regularly organized courses in organic chemistry who are studying the subject or to those who, although they have had a complete course, have been out of contact with the subject and wish guidance in reviewing it.

T. C. TAYLOR.

Technical News of the Week

Current Events in the Chemical, Metallurgical and Allied Industrial Fields—Legislative Developments—Activities of Government Bureaus, Technical Societies and Trade Associations

Chemical Equipment Manufacturers Organize Trade Association

The Chemical Equipment Manufacturers Association was organized at a meeting of representatives of the industry held in the Chemists' Club, New York, on May 11. The association is the outgrowth of a movement begun last fall by twenty-five manufacturers of chemical equipment who were exhibitors at the Seventh National Exposition of Chemical Industries. They were brought together at that time to consider some matters relating to the Exposition, but realizing that there were other and perhaps more substantial reasons for organizing a permanent trade association, they have been active since last fall investigating the possibilities of an association to consider problems common to manufacturers of chemical equipment. All development work has been under the direction of an executive committee consisting of J. George Lehman, chairman; A. A. Holmes, secretary; Paul O. Abbe, P. C. Kingsbury and C. H. Kimberly.

The meeting on the 11th inst. was directed by Dr. C. H. Kimberly, who has been in active charge for some months past owing to the absence of Mr. Lehman, chairman. The following manufacturers were represented at the meeting:

Company	Representatives
United Filters Corp.	R. C. Campbell
Read Machinery Co.	A. N. Bowes
The Dorr Co.	G. E. Walker
Paul O. Abbe	Paul O. Abbe
Maurice A. Knight.	{ Samuel J. Baril M. Sultz
Quigley Furnace Specialties Co.	H. T. Matthew
Vallez Rotary Filter Press, } Chemical Equipment Co., }	C. L. Bryden
Duriron Co.	M. W. Smith
Nash Engineering Co.	C. B. Wright
Walter E. Lummus Co.	W. E. Lummus
Bethlehem Foundry and Machine Co. ..	A. H. Stevens
Precision Instrument Co.	L. D. Vorce
E. B. Badger & Sons Co.	A. A. Holmes
Schutte & Koerting.	C. H. Kimberly
Aterite Co.	D. L. Dowling
General Ceramics Co.	R. S. Beecher
Oil, Paint and Drug Reporter.	E. P. Specht
Drug and Chemical Markets.	D. H. Killeffer
Journal of Industrial and Engineering Chemistry	{ H. E. Howe F. W. Robinson
Chemical Catalog Co.	{ E. G. Nellis F. M. Turner, Jr.
Chemical Age	{ R. H. McCready Lloyd Lamborn
CHEMICAL & METALLURGICAL ENGI- NEERING	{ H. C. Parmelee Irving Fellner

ADDRESSES ON TRADE ASSOCIATIONS

At the morning session there were two addresses on the general subject of trade associations: One by E. W. McCullough, chairman of the committee on fabricated production of the Chamber of Commerce of the United States, and the other by William A. Durgin, in charge of the Division of Simplified Practice in the Department of Commerce.

Mr. McCullough spoke from a broad experience with trade associations, particularly as a former secretary of an association of agricultural implement manufacturers. He emphasized the necessity of having a definite goal in starting an association of this kind. A prime necessity is a good secretary who will function as an executive and not merely as a clerk. He must not be handicapped by lack of funds,

and preferably he should hold office continuously. Mr. McCullough pointed out the necessity of co-operation between a trade association and such government agencies as the Department of Commerce and the Federal Trade Commission in order that the government can be fully advised of the problems and needs of the industry.

Mr. Durgin outlined the reorganization of the Department of Commerce by Mr. Hoover and emphasized the fact that business is better represented today in the administration at Washington than it ever has been before. The Department of Commerce is functioning as the servant of business, but it can continue so to function only if business will co-operate with it and form close contacts through trade associations. By this means business will be in a position to obtain sympathetic attention from the government. Mr. Durgin dwelt on the subject of simplification in manufacture as one of the possible activities of the Chemical Equipment Manufacturers Association.

In the discussion which followed these two addresses representatives of the industry made tentative suggestions as to possible activities for the association. Among these were questions of standardization, guarantees of equipment, trade practices and activities of second-hand dealers.

At the afternoon session those present adopted the constitution and bylaws, which is printed below. By vote of those present, the executive committee appointed last fall will continue to direct the affairs of the association until permanent officers are elected. It will act as a nominating committee to prepare for an election to be held in September and it will also serve as a membership committee.

At the evening session the association was addressed by three representatives of trade expositions, Alfred Reeves, manager of the Automobile Chamber of Commerce; Robert Everett, secretary-manager of the Association of Ice Cream Supply Men; and F. W. Payne, of the National Exposition of Chemical Industries. The remarks of the latter were of particular interest on account of the light thrown on some matters in connection with the Chemical Exposition which had not been thoroughly understood or appreciated by exhibitors.

CONSTITUTION AND BYLAWS

SECTION 1—NAME AND OBJECTS

The name of this association shall be Chemical Equipment Manufacturers' Association. The purpose of this association shall be to foster trade in chemical process equipment. In order to do this it shall be the aim of the association to:

Encourage high standards in the industry.

Promote a better knowledge of conditions controlling the industry's development.

Take steps to bring about definite understanding as to professional services rendered to purchasers in connection with sale of equipment.

Investigate conditions surrounding the resale of equipment originally produced for specific purposes.

Disseminate information as to methods of arriving at correct costs.

Standardize trade phrases.

Collect and disseminate information as to design, raw material and construction.

Take suitable and timely notice of, and action upon, matters of legislation, both national and state, which affect the members of this association.

Collect and disseminate market statistics both domestic and foreign.

Collect and disseminate information as to labor conditions and relations.

And enter into such other legitimate trade association activities as may be deemed in the interest and welfare of the industry.

It is distinctly understood that this association will not

undertake any activity which will restrain trade, limit production or competition, regulate prices, or otherwise be in violation of the law.

SECTION 2—MEMBERSHIP

Membership shall be divided into three classes: active, associate, and honorary.

Active membership shall be composed of manufacturers and their agents and others engaged in the manufacture and sale of equipment and accessories used in the chemical industries and industries using chemical processes. Only active members shall vote and hold office.

The associate membership shall be composed of such individuals, firms or corporations as are interested in the activities of the association. For example, consulting engineers and technical publications.

Any individual, firm or corporation qualifying for either of the above classes of membership, upon recommendation of the membership committee and the majority vote of the board of directors, and upon subscribing to the constitution and bylaws of the association, shall be declared elected to membership of this association. Payment of the annual dues shall be required within 30 days after election.

When a member has ceased from active participation in the work of the association, either because of retirement from business or change of position and has rendered distinguished service, either to the association or the industry, he may be accorded the rank of honorary member.

During term of office the presiding officer of affiliated technical societies such as A.C.S., A.I.C.E., A.O.C.S., etc. may also be accorded the rank of honorary member.

The proven participation of any member in any agreement to restrain trade, limit production or competition, regulate prices, or of other conduct prejudicial to the interests of the association, shall be reason for immediate expulsion by a majority vote of the board of directors.

SECTION 3—BOARD OF DIRECTORS

There shall be a board of directors of seven members consisting of the president, ex-officio, and six others elected by the association. Of the original board, two members shall serve for 3 years, two members for 2 years and two members for 1 year from date of election. Thereafter, members of the board shall be elected annually to serve for 3 years. They shall have general supervision over the affairs of the association.

SECTION 4—OFFICERS

The officers of the association shall be: president, vice-president and a secretary-treasurer.

Officers shall be elected at the annual meeting of the association. Ninety days prior to the annual meeting the president shall appoint a nominating committee of three who shall select at least two candidates for each office to be filled. Any other candidates can be nominated in writing by five or more active members of the association. All nominations shall be placed in alphabetical order on the ballot, which shall be mailed 30 days before the annual meeting. The ballots may be mailed to the secretary or brought to the annual meeting in envelopes unmarked, these envelopes being inclosed in others having the signature of the member voting. The nominee for each office receiving the highest number of votes shall be declared elected. In case of a tie the board of directors shall elect one of the two.

No member of the association shall be elected to the office of president more than twice in succession and there shall be a lapse of at least 3 years before he shall again be eligible for such position. The president and vice-president will hold office 1 year or until their successors are elected and qualified.

SECTION 5—DUTIES OF OFFICERS

The duties of the officers shall be as follows:

The president shall preside at all meetings of the association and act as an ex-officio member of board of directors. In his absence, the vice-president shall preside. In the absence of both the president and the vice-president, the members present at any meeting may by a majority vote, elect a chairman pro tem. to preside over such a meeting.

The following standing committees shall be appointed annually by the president, each to consist of at least three members: Membership, Standardization, Business Ethics, Industrial Relations, Statistics, Legislative and Publicity.

The secretary-treasurer shall be appointed by the board of directors and be directly responsible to them. The secretary-treasurer shall keep proper records of the meetings and all formal actions of the association and its committees. He shall have the custody of all its records and papers in general. Statistics and other confidential information received from members shall not be communicated to other members without specific permission of the member giving same, but nothing in this section shall be construed to prohibit the compiling of records and statistics *en bloc* or in totals and the furnishing of such compilations to all the members. He shall on request give to the president the names of members reporting and not reporting. He shall on order of the president issue written notices of all meetings of the association to members. He shall have the custody of and receive and disburse all funds of the association. He shall give bond in such sum and with such surety as the board of directors shall determine and such bond shall be held in custody of the president.

The books and accounts of the secretary-treasurer shall be audited at least once a year by a suitable disinterested accountant to be selected by the board of directors. Such accountant shall not be connected with the chemical process equipment industry.

The secretary-treasurer shall hold office during the pleasure of the board of directors.

SECTION 6—DUES

The annual dues of the active members shall be \$100.

The annual dues of the associate members shall be \$50.

Honorary members shall not be subject to either dues or assessments.

There shall be an initiation fee, the amount to be determined by the board of directors and it shall become effective when so determined.

The first annual dues are payable within 30 days of election; thereafter dues are payable quarterly at the option of the member. Membership shall be dated from the first of the quarter during which the member is elected.

Any member who shall become 90 days in arrears for dues and assessments shall cease to enjoy any benefits of the association. If he shall become 6 months in arrears he shall be subject to expulsion at the discretion of the board of directors.

Funds required in excess of revenue from dues are to be secured by assessment upon active members upon a basis to be determined by the board of directors and accepted by the members of the association. The association may also accept gifts, subscriptions and other funds for specific and general purposes.

SECTION 7—MEETINGS

The annual meeting shall be during the month of September and at the main office of the association.

The president shall call all other meetings of the association. In his inability, the vice-president shall have power to do so. A meeting shall be called at the written request of any seven members of the association.

At any business meeting the association members may be represented and vote as follows: Representation at the meetings of the association shall be only by designated representatives of the members, each member to have one vote.

SECTION 8—PUBLICITY

The records of the association, its files and its correspondence and its meetings shall be open at all times to any public official who in the performance of his duties is legally authorized to investigate the workings of the association; the fundamental object of the association being perfect frankness and openness in all of its activities.

SECTION 9—AMENDMENTS

This constitution may be amended by a vote of three-quarters of the members present at any annual meeting,

provided a notice of such amendment has been sent to all members by the secretary 60 days in advance of such meeting.

SECTION 10—ORDER OF BUSINESS

The order of the business shall be as follows:

1. Calling the roll.
2. Reading minutes.
3. Election of officers.
4. Reports of officers.
5. Reports of committees.
6. Receiving communications.
7. Unfinished business.
8. New business.

SECTION 11

On points not specifically covered, Robert's Manual shall be considered as basis for rules of order.

Browne and Dow Address Joint Meeting of New York Chemical Societies

New York chemists who missed the joint meeting of the local chemical societies held under the direction of the American Section of the Société de Chimie Industrielle in Rumford Hall on May 12 have much to regret. The evening's program, featured by two intensely interesting addresses dealing with different phases of chemical history, proved to be one of the rarest treats of the season. Dr. C. A. Browne, chief chemist, New York Sugar Trade Laboratory, who is one of our few outstanding recorders of the history of American chemistry, spoke on "Early Chemical Industry in America—A Few Comparisons of Past With Present Conditions." Dr. Herbert H. Dow, president, Dow Chemical Co., followed with a very vivid and engaging account of some of his own experiences "in extracting dividends from chemical processes."

Dr. Browne's diligent searches into the archives of the Congressional Library have recently revealed records of the first chemical operations in the United States. In 1535 a party of Spaniards on their way into Mexico found certain pigments and bright minerals among the members of an Indian tribe and after tracing these to their sources, they discovered crude metallurgical operations in which the natives were smelting and refining precious metals. From this beginning we can follow the progress of the Spaniards, and later on the French, in exploiting the gold and silver of the new continent. In the New York colony the first of the chemical industries was the refining of sugar by the Dutch. As early as 1689 a large sugar refinery had been built in Liberty St. and continued its operations almost up to Revolutionary times. John Winthrop, early Governor of Connecticut, however, may be said to be the first American industrial chemist. Over 250 years ago he was manufacturing salt, recovering saltpeter and sulphur and making gunpowder. Dr. Browne, in his searches through the files of the Massachusetts Historical Society, has unearthed a number of interesting documents showing the alchemistic experiments and researches of this early American investigator.

The most startling of Dr. Browne's revelations, however, was the comparison of economic conditions in the chemical industry in the period 1806-1826 with those which have existed since 1914. Developments in the early days were almost identical with those we have just experienced. The expansion to meet the demands of the Napoleonic wars, followed by those of our own war of 1812, was repeated in 1914 and in 1917-18. Following the war of 1812 our chemical ancestors made every effort to hold onto their industrial gains and petitions for embargoes, tariff protection and patent legislation were as evident then as they have been in recent years.

A BROMINE INDUSTRY DEVELOPED UNDER DIFFICULTIES

As is often the case in the commercialization of a chemical process, the early development of the American bromine industry was beset with almost insurmountable difficulties. But Mr. Dow early demonstrated that he was as much a business man as a chemist and the great industry at Midland which bears his name is evidence of his success in solving

financial as well as technical difficulties. Beginning with his early and unsuccessful attempt to recover lithium from a salt brine near Cleveland in 1888, the speaker recounted his personal experiences which gradually culminated into a profitable method for extracting bromine. After his first bromine adventure had failed, Mr. Dow went to Midland, Mich., and purchased a brine-well property for \$100. This was in 1890 and the next 5 years was spent in costly development and experimentation with plant processes. The first plant troubles were with the brine pumps and final success of the operation may be said to date from the development of an improvised check valve used on this particular pump.

Mr. Dow concluded his talk with a review of the sidelines developed in connection with the industry and as example showed how Dow metal, the new magnesium alloy, had its origin. This alloy has certain interesting properties which indicate that it may be destined greatly to affect the construction of the internal combustion engine.

RESOLUTIONS IN MEMORY OF DR. BASKERVILLE

This was the first meeting of the American Section of the Société since the death of its vice-president, Dr. Charles Baskerville, and President J. Enrique Zanetti read the following resolution which was unanimously adopted as a respectful recognition of the memory of this illustrious investigator:

The Société de Chimie Industrielle has suffered a great loss in the passing of Dr. Charles Baskerville. He was able in counsel, sound in scholarship, kind and generous in disposition and prolific in invention. As a man of science, as professor and as head of the department of chemistry of the College of the City of New York, he was at once competent, clear of vision and keen of understanding; a constant friend to those serving with him and under his direction and an enduring source of inspiration to his students. He was both a gifted teacher and an administrator of rare ability.

Besides his endowment of far vision and his diligence in research along with the fulfillment of his many duties, he was a joyous companion and bountiful in the benefactions of his friendship. In this he was always guided by magnanimous generosity toward others while holding close to high ideals of thought and action for himself.

His presence added distinction, learning and wisdom to the Council. His death is a heavy burden, his memory a precious inheritance.

Patent Convention With Germany Revived

After an extended study of all the ramifications of the proposal that the Patent Convention of 1909 with Germany be permitted to lapse, the State Department decided to revive the convention, and notice to that effect was transmitted to the German authorities prior to May 11, which was the time limit for such notification. The revival of this convention gives the holders of American patents registered in Germany immunity from the working clause in the German patent law. Strong pressure was brought by the War Department and the chemical industry against the revival of the convention. The War Department is anxious to obtain the enactment of a working clause to apply to all patents registered in the United States. The American chemical industry has comparatively few patents registered abroad. On the other hand Germany has a large number of patents registered in this country which are not being worked.

Manufacturers of machinery in the United States were among those who were most strongly in favor of reinstating the convention with Germany. It was stated that it would cost machinery manufacturers millions of dollars to undertake the manufacture of their patents in Germany.

The effective date of the revival of the treaty is May 8, 1922. This means that no change can be made without 1 year's notice. The Patent Committee is going ahead with the new Stanley bill, which is the bill drafted by Henry Howard, president of the American Institute of Chemical Engineers. Since the urgency for legislation has passed, it is probable that action on the bill will lag, although the hope is expressed in some quarters that favorable action will be taken.

Annual Conference on Weights and Measures

The fifteenth annual conference on weights and measures will be held at the Bureau of Standards at Washington, May 23 to 26. These conferences are attended by government officials interested in weights and measures and by weights and measures officials of states, cities and counties. The sessions also are attended by manufacturers of apparatus and by representatives of industries interested in the general subject. A feature of each of these conferences is the display of manufacturers' exhibits of weighing and measuring apparatus.

The program includes an address by the Secretary of Commerce. C. A. Briggs, of the Bureau of Standards staff, has taken as his subject "The Metric System: How Would It Be Put Into Effect?" H. W. Bearce, also an official of the Bureau of Standards, will discuss "The Fundamental Standard of Length."

Technical and Industrial Photography to Be Fostered by New Society

At a meeting held in the Chemists' Club, New York City, on May 10 the organization of a society of technical and industrial photographers was consummated. The new society will be known as the Technical Photographic and Microscopical Society. Officers elected were as follows: President, James McDowell, of the Sharp & Hamilton Manufacturing Co., Boston, Mass.; secretary-treasurer, T. J. Keenan, editor of *Paper*; vice-presidents, J. H. Graff, of the Brown Co., Berlin, N. H., and B. Grotta of the Atlas Powder Co., Tamaqua, Pa.

A luncheon meeting of the society at the Hotel Astor, New York, is scheduled for June 15, at which time the members will be addressed by speakers prominent in the field of industrial photography. At this meeting additional steps will be taken for the establishment of a permanent organization, and an invitation is extended to all individuals or organizations interested in technical and industrial photography to attend or send representatives to this meeting.

The aim of the organization is to promote the advance and extension of photography in its applications in industry and business by co-operation among those engaged in the work and among the industries which the art serves. The membership will be made up not of photographers primarily, but of technical men who depend upon photography for aid in their control and research problems. Industrial and technical photography should not be confused with commercial photography, although these two branches often overlap, and the commercial photographer in many instances has done much for the full appreciation of the value of photography in industry and science. The problems of industrial photography are many-sided and interwoven so much with the knowledge of other sciences—namely, administration, engineering, chemistry, physics, optics and mathematics—that it is absolutely impossible for them to be covered by the average commercial photographer.

THE FIELD OF TECHNICAL PHOTOGRAPHY

The society will be concerned in work done with the ordinary camera as a tool of management, making photographic records of control and record boards, photographs of accidents and damages, photographs demonstrating evidence of waste and salvage, demonstration of safety ideas and accident prevention, for copying drawings and documents, standardizing records, as an aid to the engineer making progress reports of construction, and illustrations for field investigation, trade reports and industrial reports.

Another important field is in photomicrographic and macrographic work. This work, which formerly was only done by the scientist in pure research, is now more and more used to solve daily commercial and industrial problems. It is of increasing importance in metallography, textile, pulp and paper industries, cement, explosives, colloidal solutions, physical chemistry, bacteriology, rubber, leather and paint industries. The study of the raw material or the finished product is, however, only a small part of the work. The biggest value is in ability to record and com-

pare the result of the different chemical and physical processes of production.

A third field of interest covers photographic work needing specially constructed equipment. Many industrial and technical problems in photography require specially designed apparatus and equipment, of which it is only necessary to mention a few, illustrating the immense scope of this work, as for example, special equipment making it possible to take photographs of physical phenomena and illustrating the workings of physical laws, photomicrographic moving picture machines, and special moving picture cameras, making it possible to study the detail of motions or the breaks or stress of physical tests.

SOCIETY PLANS EXHIBIT

An exhibition of technical and industrial photography showing some of its unique and interesting applications will be given by the new society at the Chemical Exposition in New York in September. The exhibit will include samples of work on textiles, pulp and paper, leather and other industries, besides a display of new apparatus used in modern technical photographic laboratories.

Research Last Branch of C.W.S. to Be Cut— Sentiment on Chemical Warfare Changing

After July 1, unless the Senate should increase greatly the amount to be appropriated for the Chemical Warfare Service, numerous activities of the Service will have to be skeletonized and reduced to a standby status. Research will suffer least of all. It is intended to maintain research at the expense of every other activity.

Evidence is reaching the Chemical Warfare Service that the adoption of the so-called gas treaty has not been entirely adverse to the development of chemical warfare. The discussion of the treaty has had an educational effect in that it has acquainted additional thousands with the fact that chemical weapons are the most humane which can be used in warfare.

GRADUAL CHANGE IN SENTIMENT TOWARD C.W.S.

Formerly a considerable portion of the army itself looked upon chemical warfare with much skepticism. The General Staff was avowedly hostile to the importance which Congress attached to the Service and was inclined to belittle its possibilities. Sentiment in the army itself has changed to the point where practically every officer is an advocate of chemical warfare. A notable exception is General Pershing. No satisfactory explanation ever has been put forward for the change in the views on this subject of the General of the armies. It is fully believed that he expressed his real personal views in his testimony before the Military Affairs Committee, and that he was influenced at the time the treaties were being negotiated by the desire of the Secretary of State to align the United States with what would be generally understood throughout the world as the more humane policy.

Much significance is attached by the army and navy air services to the capture of a naval squadron by Chinese air forces. In the face of effective bomb dropping the whole squadron soon ran up the white flag. While the bombs used were of the high-explosive character, it is pointed out that even more prompt results could have been obtained had they been gas bombs and the loss of life probably would have been avoidable.

Columbia Announces Summer Courses

A series of summer courses in advanced branches of chemistry and chemical engineering, physics, electrical engineering and mathematics is announced by Columbia University, New York City, for the session July 10 to Aug. 18, 1922. The courses in chemistry include general inorganic, colloid chemistry, physical chemistry, food chemistry and organic chemistry. The chemical engineering program includes courses in fuel chemistry, illuminating gas, industrial chemistry and research engineering. Full details will be sent upon application to the secretary of Columbia University, New York City.

House Bill Would Provide for Development of Helium

The conservation, production and exploitation of helium gas under the Interior Department is contemplated in a bill introduced by Representative Kahn of California. The bill transfers all helium activities to this department and would forbid the exportation of helium except upon approval of the President. Helium would be first supplied to meet requirements of the War and Navy Departments, the surplus to be leased or sold to citizens of the United States or to commercial companies, corporations, institutions of learning or research or other agency so incorporated that the control of said companies, corporations, institutions of learning or research or other agency cannot pass out of the control of American citizens.

The bill provides that the Secretary of Interior shall purchase gas and acquire extraction rights in gases and to lease or purchase lands or the gas and oil rights in lands for the purpose of conserving and producing helium. It also directs the Department of the Interior to explore for, drill and develop such lands, rights in land, gases and rights in gases, for the purpose of securing such helium as may be required, and to store, sell or dispose of any natural gas, petroleum or valuable byproducts obtained in such development and to store the helium so produced.

Under the provisions of the bill, the Secretary of the Interior would be authorized to carry on experimental work relative to the production of helium and to acquire, establish and operate or cause to be operated such plants, accessories and facilities and to acquire rights pertaining thereto as may be necessary for the production and storage of helium.

The bill carries an appropriation of \$5,000,000 for development purposes. It directs the Secretaries of War and Navy to submit annually to the Interior Department their estimated requirements for helium to be supplied or conserved for the next fiscal year.

Senator Moses Contributes His Plaint to Testimony of Dye Investigation

Senator Moses of New Hampshire, one of the instigators of the dye investigation, contributed to the testimony before the committee for the first time on May 10, when he called several matters to the attention of the committee through William P. Pickhardt, director of Kuttroff, Pickhardt & Co., New York City. Through Mr. Pickhardt, Senator Moses presented to the committee a series of memoranda and correspondence, which Mr. Pickhardt said represented some of the objections held by consumers and by Senator Moses to the protection sought by the American organic and chemical industry.

It was evident from this correspondence that the New Hampshire Senator has been active in gathering information for the Amoskeag Manufacturing Co., of New Hampshire, and in aiding it to obtain licenses for the importation of German dyes. The correspondence was included in the record of testimony.

CONSUMERS COMPLAIN OF LICENSING DELAY

As evidence that there is cause for complaint on the part of consumers of dyes, Senator Moses called attention to the case of the Amoskeag Manufacturing Co. in obtaining an import license for indanthrene blue BCS. Application for the license had been made in this case on Nov. 14 and it was granted on Dec. 3, according to Mr. Pickhardt. Twenty-seven barrels of this dye were imported for three consumers by his company, but after the dye had been distributed to these consumers the dye and chemical control section of the Treasury had ordered it all returned to New York because of a fear that the dye was not as represented and was in reality merely a substitute for an American dye which would give the same satisfaction to users. Later on, Mr. Pickhardt said, further experiments and tests showed the dye to be as was represented and the shipment was released and the dye again was put on the importable list, Feb. 16 last.

Senator Moses had also requested him to present to the committee, Mr. Pickhardt said, a memorandum prepared

by F. S. Dickson, chief of the dye and chemical control section of the Treasury Department, dealing with the authority for importation of German dyes through the reparations commission and the Textile Alliance, under the peace treaty. The New Hampshire Senator also had Mr. Pickhardt place in the record a report made to the Textile Alliance by Edward S. Chapin, its representative in Paris, and another report by Mr. Chapin to the State Department, and other correspondence on various phases of the general situation, including correspondence with Mr. Pickhardt and the Amoskeag Manufacturing Co.

DESCRIBES ACTIVITIES OF KUTTROFF, PICKHARDT & CO.

History of the activities of his firm, which prior to the war was the exclusive agent in the United States of the Badische Anilin- und Soda-Fabrik, one of the largest members of the present German cartel, was begun by Mr. Pickhardt following his presentation of the material prepared by Senator Moses. Mr. Pickhardt said that there had been so much talk about his own activities that he wished to give the committee a complete and detailed history of them, particularly with regard to his efforts to import German dyestuffs since the signing of the armistice.

Imported dyes handled by his concern since the armistice, he said in response to a question, were very much in the minority in value and a much smaller percentage in quantity of the total of American and foreign dyes handled.

Delay in getting German dyes needed by American consumers following the armistice was "due to a desire on the part of special interests to eliminate importers from the dye industry," Mr. Pickhardt said, and this desire had been placed above the desire of the State Department, which was solely to obtain dyes needed by American consumers.

SAY CONSUMERS ARE BACK OF MANUFACTURERS

Thomas Frusher, of the United States Woolen Co., stated that "90 per cent of the consumers of the country are opposed to the embargo, but they say that if the dye men need another year, why, give it to them," he declared. "I want to help the American industry, but I don't want an inefficient government organization telling me that we can have this or must try a substitute for that."

Mr. Frusher deplored the necessity of obtaining a license to import dyes which are not made in this country. His objection was based on the delay involved in obtaining a license, a circumstance which Mr. Frusher laid at the door of those charged with administering the system. He urged that the government publish a monthly list of dyes made in the United States and that consumers be permitted to import without license all dyes not named therein.

Bureau of Mines Asks Aid of Industry in Compiling Coal Storage Data

The Bureau of Mines has issued a call to industries using coal for help in compiling exact information on the problems involved in the storage of coal. Every coal user is requested to give the Bureau the benefit of his views and conclusions on the subjects of handling and transportation costs and the investment, fixed charges, etc., involved.

While there has been much agitation of the possibilities of coal storage for giving more regular mining and movement of coal, there is very little exact information available. It is for such exact data and working costs that the bureau is calling upon the industries.

Among the specific points on which information is desired are the following: Method of storage, location with reference to point where coal is used, quantity stored, methods of preventing spontaneous combustion, method of handling fires, devices used for observing temperature, deterioration in stored coal, danger point as regards temperature, tonnage per acre, depth of pile, kinds of coal stored, cost of plant, maintenance and handling and effect of climate on stored coal.

Information on these subjects should be sent to F. R. Wadleigh, Fuel Division, Department of Commerce, Washington, D. C.

Senate Drags Through "A's" of Chemical Schedule Strongly Supporting Committee Amendments

If the progress made by the Senate on paragraph 1 of the chemical schedule is a criterion, snow will fly long before the discussion of the measure is concluded. Consideration of the tariff began on April 20. It has been demonstrated clearly that the committee has the votes to put through practically all of its amendments. Despite this fact, progress has been very slow. The Senate has been held in session for much longer periods each day than is the custom. The rules in regard to interruptions are being enforced with more than the usual rigor, but despite the application of the spur, it has been very difficult to bring the Senate to the point of voting on the amendments.

While the acid paragraph is regarded as an important one, the commodities contained in it would not have provoked the amount of discussion devoted to them had it not been for the fact that this is the first paragraph of the bill. This naturally has led to much discussion of principles underlying tariff making.

SENATE STANDS BY COMMITTEE

When the Senate does reach the point of a vote, very frequently no roll call is required. When the roll is called, the support for the committee amendment is overwhelming. For instance, the committee increased the duty on lactic acid from 1½ cents to 2 cents per pound. The vote on that amendment was 40 to 23. The committee proposal to make the duty on arsenic acid 3 cents per pound and on white arsenic 2 cents per pound was carried by votes of 40 to 18 and 34 to 16 respectively.

That the majority is standing with the committee is evidenced further by the fact that amendments to increase rates of duty are being voted down. Senator McCormick, of Illinois, for instance, proposed to increase the duty on formic acid from 4 to 6 cents. It was contended on behalf of this amendment that a 6 cent duty is necessary to place the American industry on an equal footing with manufacturers of that acid in Germany, nevertheless the proposal was voted down decisively. In the consideration of that item, Senator McCumber explained that the specific duty of 4 cents a pound practically is the equivalent of the 25 per cent ad valorem rate assessed in the House bill. In that connection Senator McCumber explained again that it is the policy of the committee to impose specific duties wherever possible so that the amount collected will be the same regardless of the country of origin. This led Senator Hitchcock to ask if it is the purpose to shut out chemical imports from Germany. Senator McCumber replied that the 4-cent rate will not reduce the volume of formic acid being imported.

FOREIGN MARKETS AND COMPETITION

During the debate figures were presented showing that we are selling more chemicals to Germany than we are purchasing from that country. Senator McCumber expressed the belief that such a condition would not be lasting. "We know," he said, "something about the cheap labor and the cheap production of chemicals in Germany. I do not expect we are going to continue to sell chemicals to Germany."

"For 50 years," declared Senator McCumber, "we have sold Great Britain two to three times as much as we have bought from her, the balance of trade always has been immensely in our favor, yet Great Britain was able to buy our products. I think in a very short time Germany will drive the United States out of the markets of South America and many other countries, and that she will produce a sufficient balance of trade in her favor to use the same amount of money for purchasing American products. I do not think there has to be an exact balancing of trade as between any two nations."

In reply to the suggestion that the allied countries could pay their obligation to this country only in goods, Senator McCumber expressed the opinion that it would be better to lose the money then to allow these countries to pay us in goods when that would mean the closing of our own mills and factories. He also expressed the opinion that prices

never will recede to the pre-war level. He pointed out that despite the deflation which has taken place, the volume of currency per capita in the United States at this time is double the pre-war volume.

LONG DEBATE ON ARSENIC

The proposal to put a duty on arsenic—a commodity which can be produced easily in quantities in excess of domestic requirements—occasioned lengthy debate. It was justified by the committee on the ground that the smelters are compelled to produce arsenic so as to prevent damage to vegetation, and that they should be permitted to obtain at least the cost of its recovery. It was pointed out that with the development of the smelting industry in Japan, that country is offering arsenic at American ports at less than the cost of production. Unless this duty is granted, it would have the effect of handicapping our ability to export metals in that the losses on arsenic would have to be added to the cost of metal production.

Engineer Volunteers Help to Government in Reaching Muscle Shoals Decision

William McClellan, president of the American Institute of Electrical Engineers and a member of the executive board of the Federated American Engineering Societies, appeared before the Senate Committee on Agriculture, May 9, to give his views in regard to the handling of the Muscle Shoals project.

He emphasized the desirability of protecting the existing construction and equipment against deterioration and advocated the formation of an engineering board of review to recommend to Congress a general plan of procedure.

Dr. McClellan bound himself to place at the disposal of Congress a committee of engineers with commercial experience who would recommend a general plan for the handling of the project from a business standpoint. He said he would arrange, through the American Institute of Electrical Engineers or through the Federated American Engineering Societies, for the services of such a committee, which would be composed of disinterested men of thoroughly established reputation.

GOVERNMENT NEEDS AID OF ENGINEERS

He also told the committee that the government should not act except on the basis of unbiased, competent, professional and business advice. "It is perhaps not unfair to say," he asserted, "that all those engineers and business men who have made detailed studies of the project have done so for some reason of their own and did not look at it from the government's standpoint. The disposal of Muscle Shoals is not a technical, engineering proposition. It is a commercial matter. The only way for the government to get an impartial review of the commercial and engineering features of the situation is for the committee of the Senate and the committee of the House jointly to request a group of not less than five engineers, who have had adequate commercial experience in large projects, to take all of the data, statements and reports which have been submitted and report to the committees what the government should do."

"The government under no circumstances," continued Dr. McClellan, "should alienate its nitrate plants until an adequate plan is agreed upon for the completion of these plants or the construction of nitrate plants at some more favorable points, should such places be found. During the period of investigation the works at Muscle Shoals can be adequately protected against deterioration. Such protection of interrupted construction work is very common among commercial companies. The government can well afford to appropriate money to render streams navigable and to regulate flow, particularly at headwaters, so as to improve the stream for power purposes."

Senator Caraway of Arkansas charged that the fertilizer trust had instituted rival offers for the nitrate plants in an effort to prevent Congressional acceptance of any offer. He likened delay in consideration of the project to that in the construction of the Panama Canal.

Division of War Minerals Supply Formed for Survey of Mineral Industries

Effective May 1, a division of war minerals supply was established in the Bureau of Mines. The new division has been charged with responsibility for matters relating to the supply of strategic minerals involved in war plans of the government, the maintenance of a proper balance of trade among the mineral industries of the nation and such related duties as may from time to time be assigned to it. H. S. Mulliken, who has for some time acted as special assistant to the director of the bureau, has been given charge of the work of this division.

The division will co-operate with the General Staff of the War Department, the United States Geological Survey, and a special committee of the A.I.M.E. in the proposed study of sources of supply and potential production of certain especially selected war minerals.

The head of the division will serve as chairman of the committee on strategic minerals of the economic liaison committee. He has further been placed in administrative charge of all activities in the production of helium that may devolve upon the Bureau of Mines, and will serve as one of the bureau's representatives on the army and navy helium board.

Bureau of Foreign and Domestic Commerce Will Establish Chemical Commodity Section

A commodity division which will specialize on the export problems of chemical industries will be set up in the Bureau of Foreign and Domestic Commerce of the Department of Commerce on July 1. This division will be comparable to the special services inaugurated last year in the interest of cotton and cotton goods, electrical goods, industrial machinery, lumber, paper and paper products and other export industries.

It was the intention a year ago to organize a chemical division, but it developed that there were numerous other industries in which the desire for this government effort was greater. It has been found, however, that while the more highly organized chemical companies are not greatly interested in receiving such assistance as the chemical commodity division could furnish, the smaller manufacturers are very much interested in obtaining this type of service. It will furnish them with much information which they could not attempt to gather for themselves.

No chief for the chemical division has been decided upon as yet, but an announcement is expected in the near future.

New Jersey Chemical Society Meeting

At a meeting of the New Jersey Chemical Society in Newark, N. J., May 8, J. F. Norris, professor of organic chemistry at Massachusetts Institute of Technology, spoke on "Recent Developments in Organic Chemistry." Prof. Norris discussed organic catalysts and other important industrial developments in the science, emphasizing the importance of pure research.

D. M. Goetschius, of the Standard Chemical Co., Pittsburgh, Pa., was scheduled to speak on "The Alpha Particle and Related Phenomena," but was prevented by sickness from attending.

Personal

EARL D. BABST, president of the American Sugar Refining Co., was the guest of honor at a dinner given at the Southern Hotel, Baltimore, Md., on May 5, in recognition of the completion of the company's new plant in this city. Governor Ritchie and Mayor Broening were among the prominent guests.

BALTZAR DE MARE, metallurgist and more recently steel superintendent for the Midvale Steel & Ordnance Co. for

approximately 20 years, now has been appointed general manager of the Union Electric Steel Co., Carnegie, Pa.

DR. PAUL M. GIESY, formerly with the Calco Chemical Co., Bound Brook, N. J., is now research chemist with E. R. Squibb & Sons, at their Brooklyn, N. Y., plant.

PAUL F. HOLSTEIN is now associated with the Buffalo Foundry & Machine Co. as its representative in Chile.

CHARLES O. LAVETT has resigned his position as engineer of tests and field erection with the Buffalo Foundry & Machine Co. Mr. Lavett was in active charge of the research laboratory for this company and has been responsible for considerable of the development in "Buflovak" drying and evaporating apparatus. He has been with the company for about 15 years.

F. G. LILJENROTH, of Stockholm, Sweden, formerly with E. I. du Pont de Nemours & Co., has just visited the United States.

WILLIAM J. PRIESTLEY, formerly steel superintendent, naval ordnance plant, South Charleston, W. Va., has been appointed works manager, Pittsburgh Crucible Steel Co., Midland, Pa., succeeding H. P. Barnard, resigned, and has assumed his new duties. Prior to going to the naval ordnance plant, Mr. Priestley was a division superintendent at the Lehigh plant of the Bethlehem Steel Co. He was graduated from Lehigh University, class of 1908.

ROBERT C. STANLEY, formerly first vice-president of the International Nickel Co., was recently elected president. Mr. Stanley has ordered a reorganization of personnel, involving as its chief feature a new department of development and research with headquarters at 67 Wall St., New York City. This department will be under the direction of A. J. WADHAMS as manager. Associated with him will be PAUL D. MERICA, director of research.

R. T. STULL was relieved of the superintendency of the ceramic experiment station of the Bureau of Mines at Columbus, Ohio, May 1, and made supervising ceramist for the bureau as a whole. He will act under the direction of the chief mineral technologist and will have supervision in technical matters in ceramics and such related investigations of non-metallic minerals as may from time to time be assigned to him. Mr. Stull will have administrative as well as technical supervision of field work in the kiln investigation carried out in co-operation with the four heavy clay products associations, including the laboratory car "Holmes" and its crew. He will make his headquarters at Columbus, Ohio, but his services will be fully available for consultation by all branches of the bureau concerned with ceramics. GEORGE A. BOLE has been designated acting superintendent of the Ceramic Experiment Station at Columbus, Ohio.

C. K. WILLIAMS, head of C. K. Williams & Co., Easton, Pa., manufacturers of paints and varnishes, has been elected a member of the committee of manufacturers of the Philadelphia sesquicentennial by Mayor Moore.

Obituary

THOMAS S. DOHERTY, manager of the Delaware Chemical Engineering Co., of Wilmington, Del., died at his residence May 1. He was 67 years of age.

HENRY MARION HOWE, dean of American metallurgists, passed away Sunday, May 14, after a protracted illness. A biographical notice will be published in a later issue.

WILLIAM SHEPARD MANNING, JR., assistant general manager of the Solvay Process Co., Syracuse, N. Y., committed suicide May 8. He suffered from insomnia and had just returned from a health resort on the Hudson River, where he had been for 3 weeks.

EDWARD MENGE, of East Liverpool, Ohio, former president of the National Brotherhood of Operative Potters, died at his residence, April 30, after an illness of about a year's duration. He is survived by his wife and one son.

Market Conditions

IN CHEMICAL, METALLURGICAL AND ALLIED INDUSTRIES

A Survey of the Economic and Commercial Factors That Influence Trade in Chemicals and Related Commodities—Prevailing Prices and Market Letters From Principal Industrial Centers

Overcapacity, Overproduction and Overcompetition

Sydney Anderson, the chairman of the joint commission of agricultural inquiry, has given us his opinion that there are at least three basic difficulties that are undermining business progress. He lists these in three words—overcapacity, overproduction and overcompetition. Others may differ with the distinguished investigator as to the relative importance of these underlying problems, but certainly they are worthy of our very careful consideration.

Overcapacity is a subject which has had the attention of the chemical industries many times within the past few years. Only recently in these columns we have had occasion to point out the difficulties of gaging productive capacity in terms of our distant mental concept of pre-war production. Such a starting point for appraising our industries fails to take account of the normal increase in the volume of manufacturing. This over a long period of years has been shown to average almost 4 per cent each year. In other words, if business had followed its normal and ordinary trend, our productive capacity today would be at least a third greater than in 1913.

Perhaps in the aggregate we have not materially exceeded this figure, but many individual industries have been extended far beyond their normal limits. No less an authority than Walter Renton Ingalls is responsible for the statement that in a part of our industrial field we now have an excessive capacity varying from 50 to 100 per cent. That this applies with particular emphasis in the chemical and metal industries, there can be no doubt. Here military demands of a stupendous character were followed by a post-war boom and an artificial and overdeveloped export trade. Naturally the period of readjustment and deflation has been most trying in these industries and there has been a tendency to cling to capacities far in excess of any possible demands.

The second problem cited by Mr. Anderson is perhaps not so evident. Production today is far beneath the normal, although probably no farther than is the present consuming capacity. But it is the constantly recurring surpluses that interrupt our progress and result in unpleasant situations such as the one from which industry is just now emerging. Overproduction is the natural sequence of overcapacity, although not necessarily so. Rather it is because in a highly specialized division of labor and industry it is impossible quickly to adjust production to the changing requirements of consumption. As the saturation points are exceeded for the individual commodities, surpluses pile up and industry suffers. The consumers' gains by the lower prices are more than swallowed up in the resulting unemployment and industrial stagnation.

In the minds of some of our legislators there is no such

evil as overcompetition, which has been listed as the third of our underlying problems. The business man, however, who has witnessed its destructive effects is likely to regard it as the most serious of the three. The very commendable desire to make two chain stores grow where but one grew before is often the beginning of a process which when carried to its extremes results in price cutting and other demoralizing business practices. It is in the highly competitive situation especially such as follows a period of overproduction, that most of the losses of industry are incurred.

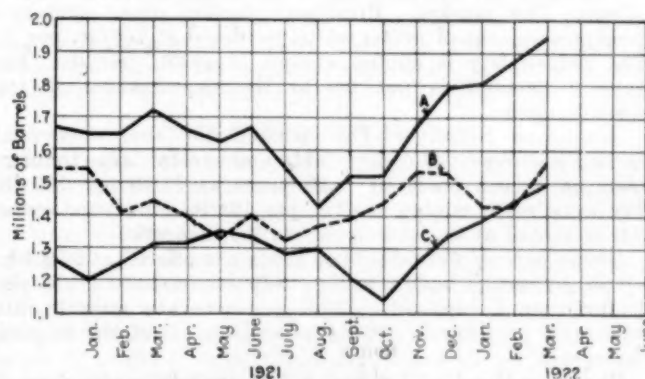
It is scarcely fair to list these industrial ailments without some mention of the palliative measures which are already being undertaken. Business men, economists and government officials are giving serious thought to these problems. The National Foreign Trade Convention which met last week in Philadelphia has tried to show that through the development of international commerce we can provide an outlet for the products of our overbuilt industries. Secretary Hoover and his co-workers in Washington have attempted to provide accurate statistics of production and consumption in the belief that through their use industry can avoid the constantly recurring peaks and valleys of the business cycle. And finally we have the recent impetus given to the study of the scope and activities of the trade associations—a development which is throwing new light on the meaning of competition and its relation to business conditions.

Thus the three "overs" of industry are being studied from many different angles and probably no small part of the present gradual improvement in business is directly traceable to the cumulative effects of such fundamental thinking.

Record Petroleum Production During March and April

During the month of March the petroleum industry set new high records in all directions. The production of crude oil totaled 46,916,000 bbl., which may be compared with the previous record output last January of 43,141,000 bbl. Consumption of crude oil amounted to 48,840,000 bbl., which makes it the highest on record. The previous maximum was in August, 1920, with a total of 48,732,000 bbl. Imports amounted to 14,004,000 bbl. which have been exceeded only once—viz., in November, 1920, with a total 14,136,000 bbl.

The huge production, combined with heavy imports, re-



MONTHLY CHANGES IN DAILY AVERAGE RATE OF—

- (A) Domestic production of petroleum plus imports of crude oil.
(B) Estimated consumption of domestic and imported petroleum.
(C) Domestic production (petroleum transported from producing properties).

(Data from U. S. Geological Survey)

CHEMICAL & METALLURGICAL ENGINEERING'S WEIGHTED INDEX OF CHEMICAL PRICES

Base = 100 for the year July 1, 1913, to June 30, 1914

This week	160.20
Last week	159.77
May, 1917	222
May, 1920	279
April, 1918 (high)	286
April, 1921 (low)	140

This week's index number shows a net gain of 0.43 due primarily to the increase in the price of crude cottonseed oil, caustic soda and saltcake. Slightly lower prices were reported for 66 deg. sulphuric acid, ammonium sulphate, caustic potash and aniline oil but the cumulative effect was not sufficient to offset the upward tendency of the index number.

sulted in an increase of 12,000,000 bbl. in stocks, in spite of the heavy consumption. Stocks amounting to 220,233,000 bbl. are far in excess of anything heretofore recorded.

Apparently, however, there will be a slight recession during April. The American Petroleum Institute's estimated daily average for the 4 weeks of that month have been as follows:

	April 8	Week Ended April 15	April 22	April 29
Oklahoma.....	365,000	363,200	363,500	374,350
Kansas.....	81,500	81,000	82,200	82,000
North Texas.....	52,100	52,300	52,250	52,300
Central Texas.....	168,150	153,800	149,950	149,300
North Louisiana and Arkansas	141,200	128,450	120,150	118,750
Gulf Coast.....	114,100	114,950	111,650	114,600
Eastern.....	115,000	115,000	118,000	118,500
Wyoming and Montana.....	70,900	72,150	69,050	71,900
California.....	325,000	330,000	330,000	330,000
Total.....	1,432,950	1,410,850	1,396,750	1,411,700

Synthetic Organic Chemicals

The striking expansion that has occurred during the last 4 years in the manufacture and distribution of synthetic organic chemicals for scientific and industrial research is evidenced by the fact the recent price list of the Eastman laboratories contains the names of approximately 1,300 different compounds. One interesting innovation in the present list is the inclusion of the melting points, boiling ranges and other purity criteria for the larger share of the chemicals. Such data are of special value to most of the users of these products and should have the effect of encouraging improved quality and higher standards of purity in this line of chemical manufacture.

The New York Market

NEW YORK, May 15, 1922.

The chemical market has been noticeably steady during the past week and aside from slightly easier prices for one or two minor commodities, the general list has undergone no important declines. One of the leading features of the week's trading was the pronounced interest in solid caustic soda for export. Standard brand material is extremely scarce and outside brands have brought \$3.80 per 100 lb. for July shipment. The demand for oxalic acid has increased materially and the market was sharply advanced on spot and at the works by leading factors. Prussiate of soda has recorded an additional advance, with the consumers showing an increased interest. Other prussiates remain in the same firm position as previously reported. Bichromates have been neglected of late and both the soda and potash salts are slightly easier on spot. Barium chloride has eased off somewhat and prices were a shade lower in several directions. Carbonate of potash has been in fair demand. Copper sulphate is still very active, with prices quite firm on prime material. Tin oxide was reduced 2c. per lb. by makers. A slightly easier feeling was noted on caustic and permanganate of potash.

GENERAL CHEMICALS

Arsenic—Small-lot trading is about the best way to characterize this market. Prominent factors quote spot and prompt shipment of prime white powdered at 7@7½c. per lb. The red variety is quoted around 11½@12c. per lb. The general demand is not up to the expectations of the manufacturers.

Aluminum Sulphate—The demand for the commercial variety has improved considerably and several large tonnage sales have been made by first hands at \$1.50 per 100 lb. The iron-free is quoted at \$2.50 per 100 lb. Imported material is quoted at the same price as the domestic.

Bichromate of Potash—Spot goods are offered at 9½@10c. per lb. by second hands, while producers quote 9½@10c. per lb. for prompt shipment. Trading is generally quiet in this item, with first hands getting practically all of the passing business.

Bleaching Powder—Leading sellers are holding the market at \$1.60 per 100 lb., f.o.b. works, in large drums. Export containers have been sold at lower levels and \$1.40 per 100 lb. was quoted in some directions. Trading is generally quiet.

Caustic Soda—There has been no let-up from the firm position of this product. The export demand is extremely strong, with only a few odd lots available for early shipment. Prices are quoted around \$3.90 per 100 lb. f.a.s. Outside brands can be bought a shade under this price, although some factors are reported sold up through July. Quotations at the works for contracts remain quotably unchanged.

Copperas—Producers offer prime green crystals at \$20 per ton. The demand is rather quiet in all directions and the market has uncovered no features of interest.

Citric Acid—There were sales recorded at 45@46c. per lb., depending upon the quantity and seller. The demand is only moderate. Offerings were not heavy and leading dealers are looking for a stronger market with the coming hot weather.

Fluoride of Soda—Producers quote 9c. per lb. as the low figure for this material and up to 10c. per lb. for smaller quantities. The market is about up to the expectations of the manufacturers, with small lots featuring.

Oxalic Acid—Prices have been sharply advanced on this product. The best quotation heard late in the week was 13c. per lb. f.o.b. works. Spot goods were quoted at 13½@14c. per lb. Several large sales were reported during the advance and the general demand has shown considerable improvement.

Prussiate of Soda—Higher prices have been established for this material and the market closed firm at 18½c. per lb. on spot. Offerings have noticeably decreased and this has given additional strength to the item. Shipment material is higher, with sellers asking 18½@18¾c. per lb.

VEGETABLE OILS

Linseed Oil—The market for this commodity was very firm in the early trading, but was rather quiet during the latter part of the week. Leading crushers named 90c. per gal. for raw oil, in carload lots, shipment over the next 4 months. Oct.-Nov.-Dec.-contracts ranged from 92@93c. per gal. Large consumers seem to have filled requirements for nearby oil and it is believed that trading may show some brief signs of weakness. Foreign oil sold at 83c. per gal., duty paid, May shipment.

Castor Oil—Trading was somewhat quieter although prices ruled steady in sympathy with the strong seed market. Quotations remained unchanged on both the AA and No. 3 grades.

Coconut Oil—Business during the interval has been less active than in the previous week, but there were several inquiries in the market for forward delivery oil and the general condition was somewhat firm. Ceylon type oil, May-June shipment from the coast, in sellers' tanks, was offered at 7½c. per lb., May-June shipment from N. Y. at 8c. per lb., sellers' tanks. Ceylon in barrels, carload lots, sold at 8½c. per lb.

Palm Oils—The market for lagos oil was dull and prices were unsettled. There were sellers at 7½@7¾c. per lb., c.i.f. N. Y. Niger oil was quoted at 6½@6¾c. per lb., c.i.f.

The St. Louis Market

ST. LOUIS, May 11, 1922.

The volume of business transacted for the first 10 days of this month has been very gratifying, and dealers expect that there will be a material increase in the demand for industrial chemicals as well as for fine chemicals during the next few weeks.

Prices generally are firm and advances have far exceeded the number of declines for some few weeks. One of the chief reasons for the firming up of the market is that the foreign competitor has found it necessary to increase his prices, thereby eliminating price disturbances.

ALKALIS

Caustic soda remains normal in price, with a routine demand, no great volume of business having been reported. **Soda ash** has been quoted in this market as low as \$2.15 per 100 lb. in bags, \$2.35 per 100 lb. in barrels, though the prevailing price is around \$2.20 and \$2.40 respectively. Carload prices range around \$2 per 100 lb. f.o.b. purchaser's

door. *Sal soda* continues to maintain a steady price with a good demand. *Sodium bicarbonate* is being handled rather recklessly by jobbers in this market, prices ranging from \$2@\$.25 per 100 lb. in 5-bbl. lots.

GENERAL AND SPECIAL CHEMICALS

One of the heavy *mineral acid* manufacturers reports a very good undertone in spite of the fact that the steel mills are greatly hampered in their operations by the present coal strike, and if it were not for this hindrance the acid market today would be a booming one. Prices are firm with no surplus stocks. In our last report it was stated that an advance in *citric acid* would not prove surprising, but to date this increase has not taken place. However, we believe that an advance in price ought to come, because there is a scarcity of stocks and foreign goods are now being held at a higher figure. Furthermore, there will be a much greater demand in the immediate future from the soft drink manufacturers. *White arsenic powder* is firm at 6½@7c. f.o.b. New York, with the demand very quiet and a scarcity of stock. *Solid calcium chloride* is now being quoted in 1- and 5-drum lots at \$1.60 per 100 lb. f.o.b. St. Louis, with a differential of 5c. per 100 lb. in lots of 5 to 10 drums; the granular at \$1.90 per 100 lb. f.o.b. St. Louis in lots of 1 to 6 drums, with a differential of 5c. per 100 lb. in lots of 7 to 15 drums. *Carbon bisulphide*, being one of the chemicals used as an insecticide, is commanding a prominent position and undoubtedly will continue to hold same for some time. *Glycerine* is a weak sister on the market at the present. The new price of 15c. has not stimulated buying and 14½c. has been quoted on firm orders. *Zinc sulphate* is now holding at \$2.85@\$.2.90 per 100 lb. f.o.b. St. Louis and the market is stiffening in keeping with the advance in *zinc spelter*, which has increased approximately \$15 per ton within the last 60 days. It is interesting to observe that for the first time since the close of the World War there has been a large demand for zinc from European countries. There is also a good demand for *zinc dust* originating from the dye manufacturers, and prices on this commodity are also stiffening in line with the spelter.

VEGETABLE OILS AND NAVAL STORES

Linseed oil has recovered its full strength and producers are in a firmer position today than they have been for some time. On April 13 linseed oil was reported in this column at 86c. basis raw oil; today it is quoted at \$1.07. *Turpentine* has gone as low as 85c. and as high as 96c. *Castor oil* has advanced ½c. and now is in good demand at 12½c. in quantities of 200 gal., with an advance of 1c. for less quantities.

The Iron and Steel Market

PITTSBURGH, May 12, 1922.

The monthly report of steel ingot production was awaited with unusual interest, as estimates of the producing rate could not be made in April with the usual facility, since the coal strike caused curtailment of pig iron and therefore of steel production at some points, while there were increases at other points, not affected by the coal strike. Estimates made in these reports recently, that ingot production was running at a rate between 36,000,000 and 38,000,000 tons a year, are confirmed. From the report of production in April on the thirty companies that make monthly returns it may be computed that the average rate during April was 36,600,000 tons, with a probable error of a few hundred thousand tons. In January, February and March there were continuous and sharp increases, and March, with an average rate of 32,500,000 tons, as shown by the report for the month, probably opened with a 30,000,000-ton rate and closed with a 35,000,000-ton rate. Thus production must have increased somewhat during April, despite the coal strike, the gains overbalancing the losses.

MILLS ADAPTING THEMSELVES TO CONDITIONS

The mills and furnaces affected by the coal strike have done good work in promptly adapting themselves to the suddenly imposed condition. Coal has been bought in various markets, some of them quite distant, Kentucky figuring prominently. Not the least spectacular of the unusual

movements is the bringing of beehive coke from Sloss ovens in Alabama to Steel Corporation furnaces in Ohio. At several steel plants piles of pig iron, regarded a few months ago as a drug on the market, are being used. The steel works in the Pittsburgh district are certainly not reduced to extremities, for there has not been a purchase of heavy melting steel by a consumer in the district for nearly 2 weeks, although the price done in the last purchases, \$17.50, is far from prohibitive.

Prospects are that steel production, on the whole, will increase somewhat in the next few weeks. There is no sign that it will decrease from stocks of coal being exhausted, for the steel industry is obtaining, by various means, a great deal of coal. The Mingo plant of the Carnegie Steel Co., which was closed early in April, is resuming operations. The full rating of the plant is 600,000 tons of ingots a year.

STEEL MARKET STRONG

The steel market, as a market, is very strong, and is altogether in favor of sellers. Consumers who 2 months ago were reserved about buying are now urging the mills to accept additional orders and contracts. In some instances third quarter and even fourth quarter contracts are offered, the mill to name prices later. Premiums for early deliveries are occasionally offered.

Not a few of the independents' mills have advanced their asking prices and are able to make some sales at the advances. The Steel Corporation has made no regular advances, but in bars, shapes and plates is getting a slightly higher average than a week or two ago. In these products the tonnage and character of specifications have something to do with the price.

The market is still quotable at the regular prices named in the past few weeks, but in most products there are some sales at higher prices, in the case of less desirable orders or of prompt deliveries. Regular prices are: Bars, shapes and plates, 1.50c.; bands, hoops and hot-rolled strips, 2c.; standard steel pipe, 71 per cent basing discount; blue annealed sheets, 2.40c.; black sheets, 3.15c.; galvanized sheets, 4.15c.; automobile sheets, 4.50c.; tin plate, \$4.75; plain wire, 2.25c. On nails there are two prices, the Steel Corporation's price of \$2.40 and the independent price of \$2.50.

Sheet bars are now quotable at \$35, there being no possibility of less being done, while there are no regular offerings even at \$35. At the March price of \$29 sheet mills did not buy more than enough to cover their sales of sheets at old prices, based on 3c. for black, hence there is a disposition to ask more than the present market of 3.15c., with sheet bars \$6 a ton higher.

COAL AND COKE

Connellsville coal has advanced sharply, chiefly on account of Eastern buying, and is now quotable at \$3.25@\$.3.50 for steam grade. Connellsville coke is quotable at \$6.50 for furnace and \$6.75 for foundry, with limited offerings and limited demand.

One or two sales of basic pig iron are reported at \$25 valley, or \$1 over last week's nominal quotation. One merchant furnace now quotes this price, not being entirely out of the market as formerly, and names \$26 on bessemer. Foundry remains quotable at \$24. Inquiry is quite limited.

STEEL CORPORATION TONNAGE

With only trifling exceptions the Steel Corporation's unfilled obligations decreased month by month from 11,118,468 tons on July 31, 1920, to 4,141,069 tons on Feb. 28, 1922. In some months early in 1921 the decrease in a month was almost equal to the shipments, there being scarcely any bookings. Last March the unfilled obligations increased by 353,079 tons, while April showed an increase of 602,769 tons. The March increase represented 25 per cent of a month's capacity, while the shipments were about 65 per cent, making the bookings about 90 per cent of capacity. In April shipments were about 70 per cent of capacity and the increase in unfilled tonnage 45 per cent, making the bookings about 115 per cent. The bookings are chiefly for relatively early delivery, there being not much construction work involving very extended deliveries.

General Chemicals

CURRENT WHOLESALE PRICES IN NEW YORK MARKET

	Carlots	Less Carlots
Acetic anhydride.....lb.		\$0.38 - \$0.40
Acetone.....lb.	\$0.08 - \$0.09	09½ - 10
Acid, acetic, 28 per cent.....100 lbs.	2.35 - 2.50	2.55 - 3.00
Acetic, 56 per cent.....100 lbs.	5.00 - 5.25	5.30 - 5.50
Acetic, glacial, 99½ per cent, carboys.....100 lbs.	9.25 - 9.50	9.75 - 10.25
Boric, crystals.....lb.	11 - 11½	11½ - 12
Boric, powder.....lb.	11 - 11½	11½ - 12½
Citric.....lb.		45 - 46
Hydrochloric.....100 lb.	1.10 - 1.20	1.25 - 1.70
Hydrofluoric, 52 per cent.....lb.	11 - 11½	11½ - 12
Lactic, 44 per cent tech.....lb.	09½ - 10	10½ - 12
Lactic, 22 per cent tech.....lb.	04 - 04½	04½ - 05
Molybdic, n.p.....lb.	3.00 - 3.25	3.30 - 3.75
Muriatic, 20 deg. (see hydrochloric).....lb.		
Nitric, 40 deg.....lb.	06 - 06½	06½ - 07
Nitric, 42 deg.....lb.	06½ - 06	07 - 07½
Oxalic, crystals.....lb.	13 - 13½	13½ - 14
Phosphoric, 50 per cent solution.....lb.	08 - 08½	08½ - 09½
Picric.....lb.	22 - 24	24½ - 30
Pyrogallol, resublimed.....lb.		1.65 - 1.75
Sulphuric, 60 deg., tank cars.....ton	10.00 - 11.00	
Sulphuric, 60 deg., drums.....ton	12.00 - 14.00	
Sulphuric, 66 deg., tank cars.....ton	16.00 - 16.50	
Sulphuric, 66 deg., drums.....ton	20.00 - 20.50	21.00 - 22.00
Sulphuric, 66 deg., carboys.....ton		
Sulphuric, fuming, 20 per cent (oleum) tank cars.....ton	19.50 - 20.00	
Sulphuric, fuming, 20 per cent (oleum) drums.....ton	22.00 - 22.50	23.00 - 24.00
Sulphuric, fuming, 20 per cent (oleum) carboys.....ton	31.00 - 32.00	33.00 - 34.00
Tannic, U. S. P.....lb.		60 - 75
Tannic (tech.).....lb.	40 - 45	46 - 50
Tartaric, imported crystals.....lb.		27 - 28
Tartaric acid, imported, powdered.....lb.		28 - 30
Tartaric acid, domestic.....lb.		30 - 30
Tungstic, per lb. of WO.....lb.		1.00 - 1.10
Alcohol, ethyl.....gal.		4.75 - 4.95
Alcohol, methyl (see methanol).....gal.		
Alcohol, denatured, 188 proof No. 1.....gal.		32 - 34
Alcohol, denatured, 188 proof No. 5.....gal.		32 - 34
Alum, ammonia, lump.....lb.	03½ - 03½	04 - 04½
Alum, potash, lump.....lb.	03 - 04	04½ - 05
Alum, chrome lump.....lb.	07 - 08	08½ - 09½
Aluminum sulphate, commercial.....100 lb.	1.50 - 1.65	1.70 - 2.25
Aluminum sulphate, iron free.....lb.	02½ - 02½	03 - 03½
Aqua ammonia, 26 deg. drums (750 lb.).....lb.	07 - 07½	08 - 08½
Ammonia, anhydrous, cyl. (100-150 lb.).....lb.	30 - 30½	31 - 33
Ammonium carbonate, powder.....lb.	07 - 07½	07½ - 08
Ammonium nitrate.....lb.	06 - 06½	06½ - 07½
Amylacetate tech.....gal.		2.00 - 2.25
Arsenic, white, powdered.....lb.	07 - 07½	07½ - 08
Arsenic, red, powdered.....lb.	12 - 12½	12½ - 13
Barium chloride.....ton	105.00 - 105.00	106.00 - 110.00
Barium dioxide (peroxide).....lb.	20 - 21	21½ - 22
Barium nitrate.....lb.	06½ - 07	07½ - 08½
Barium sulphate (precip.) (blanc fixe).....lb.	03½ - 04	04½ - 04½
Blanc fixe, dry.....lb.	04 - 04½	
Blanc fixe, pulp.....ton	45.00 - 55.00	
Bleaching powder.....100 lb.	1.60 - 1.75	1.80 - 2.75
Blue vitriol (see copper sulphate).....lb.		06 - 06½
Borax.....lb.	05½ - 05½	
Brimstone (see sulphur, roll).....lb.		28½ - 35
Bromine.....lb.	27 - 28	
Calcium acetate.....100 lbs.	1.75 - 2.00	
Calcium carbide.....lb.	04½ - 04½	05 - 05½
Calcium chloride, fused, lump.....ton	24.00 - 24.50	24.75 - 27.00
Calcium chloride, granulated.....lb.	01½ - 01½	02 - 02½
Calcium peroxide.....lb.		1.40 - 1.50
Calcium phosphate, tribasic.....lb.		15 - 16
Camphor.....lb.		79 - 81
Carbon bisulphide.....lb.	06½ - 06½	07 - 07½
Carbon tetrachloride, drums.....lb.	09 - 10	10½ - 12
Carbonyl chloride, (phosgene).....lb.		60 - 75
Caustic potash (see potassium hydroxide).....lb.		
Caustic soda (see sodium hydroxide).....lb.		
Chalk, precip.—domestic, light.....lb.	04½ - 04½	
Chalk, precip.—domestic, heavy.....lb.	03½ - 03½	
Chalk, precip.—imported, light.....lb.	04 - 05	
Chlorine, gas, liquid-cylinders (100 lb.).....lb.	05 - 05½	05½ - 06
Chloroform.....lb.		35 - 37
Cobalt oxide.....lb.		2.00 - 2.10
Copperas.....ton	20.00 - 22.00	23.00 - 30.00
Copper carbonate, green precipitate.....lb.	19 - 20	20½ - 21
Copper cyanide.....lb.		58 - 60
Copper sulphate, crystals.....100 lb.	5.50 - 5.60	5.65 - 6.15
Cream of tartar.....lb.		25 - 26
Epsom salt (see magnesium sulphate).....lb.		
Ethyl acetate com. 85%.....gal.		60 - 65
Ethyl acetate, pure (acetic ether, 98% to 100%).....gal.		90 - 95
Formaldehyde, 40 per cent.....lb.	08 - 09	09½ - 10
Fullers earth, f.o.b. mines.....net ton	16.00 - 17.00	
Fullers earth—imported powdered—net ton	30.00 - 32.00	
Fusel oil, ref.....gal.		2.15 - 2.50
Fusel oil, crude.....gal.		1.30 - 1.50
Glauber's salt (see sodium sulphate).....lb.		
Glycerine, a. p. drums extra.....lb.		15 - 15½
Iodine, resublimed.....lb.		4.05 - 4.15
Iron oxide, red.....lb.		12 - 18
Lead acetate.....lb.		09½ - 12
Lead arsenate, powd.....lb.	14 - 14½	14½ - 15½
Lead nitrate.....lb.		15 - 20
Litharge.....lb.	07½ - 08	08½ - 09
Magnesium carbonate, technical.....lb.	08 - 08½	08½ - 09
Magnesium sulphate, U. S. P.....100 lb.	2.50 - 2.60	2.65 - 2.85
Magnesium sulphate, technical.....100 lb.		1.00 - 1.80
Methanol, 95%.....gal.		57 - 58
Methanol, 97%.....gal.		59 - 60
Nickel salt, double.....lb.		11 - 11½
Nickel salt, single.....lb.		11 - 11½
Phosgene (see carbonyl chloride).....lb.		
Phosphorus, red.....lb.	45 - 46	47 - 50
Phosphorus, yellow.....lb.		30 - 35

	Carlots	Less Carlots
Potassium bichromate.....lb.	09½ - 10	10½ - 10½
Potassium bromide, granular.....lb.		17 - 20
Potassium carbonate, U. S. P.....lb.	12 - 12½	13 - 16
Potassium carbonate, 80-85%.....lb.	05 - 05½	05½ - 06
Potassium chlorate, powdered and crystals.....lb.	06½ - 06½	07 - 08½
Potassium cyanide.....lb.		42 - 45
Potassium hydroxide (caustic potash).....100 lb.	6.00 - 6.25	6.30 - 7.00
Potassium iodide.....lb.		3.10 - 3.15
Potassium nitrate.....lb.	07½ - 07½	08 - 09
Potassium permanganate.....lb.	14 - 15	15½ - 22
Potassium prussiate, red.....lb.	nominal	nominal
Potassium prussiate, yellow.....lb.	28½ - 29	29½ - 29½
Rochelle salts (see sodium potas. tartrate).....lb.		
Salammoniac, white, granular.....lb.	07 - 07½	07½ - 08
Salammoniac, gray, granular.....lb.	07½ - 07½	07½ - 08
Salsoda.....100 lb.	1.40 - 1.45	1.50 - 1.80
Salt cake (bulk).....ton	20.00 - 25.00	
Soda ash, light, 58 per cent flat, bags, contract.....100 lb.	1.65 - 1.70	2.00 - 2.25
Soda ash, light, 58 per cent flat, bags, resale.....100 lb.	1.90 - 2.00	2.10 - 2.50
Soda ash, dense.....100 lb.	1.95 - 2.05	2.10 - 2.60
Sodium acetate.....lb.	05 - 05½	05½ - 06
Sodium bicarbonate.....100 lb.	1.80 - 1.90	1.95 - 2.40
Sodium bichromate.....lb.	07½ - 07½	07½ - 08
Sodium bisulphate (nitre cake).....ton	4.50 - 4.60	4.65 - 5.50
Sodium bisulphate powdered, U.S.P.....lb.	04½ - 04½	04½ - 05½
Sodium chlorate.....lb.	06 - 06½	06½ - 07
Sodium chloride.....long ton	12.00 - 13.00	
Sodium cyanide.....lb.	22 - 23	23½ - 25
Sodium fluoride.....lb.	09 - 09½	09½ - 10
Sodium hydroxide (caustic soda) solid, 76 per cent flat, drums, contract.....100 lb.	3.35 - 3.50	3.80 - 4.00
Sodium hydroxide (caustic soda) solid, 76% flat, drums, resale.....100 lb.	3.90 - 3.95	4.00 - 4.25
Sodium hydroxide (caustic soda), ground and flake, contracts.....100 lb.	3.85 - 4.00	4.30 - 4.50
Sodium hydroxide (caustic soda) ground and flake, resale.....100 lb.	4.00 - 4.15	4.40 - 4.60
Sodium hyposulphite.....lb.	03 - 03½	03½ - 03½
Sodium nitrite.....lb.	08½ - 09	09½ - 09½
Sodium peroxide, powdered.....lb.	28 - 30	31 - 35
Sodium phosphate, dibasic.....lb.	03½ - 04	04½ - 04½
Sodium potassium tartrate (Rochelle salt).....lb.		18 - 21
Sodium prussiate, yellow.....lb.	18½ - 19	19½ - 19½
Sodium silicate, solution (40 deg.).....100 lb.	85 - 1.00	1.05 - 1.25
Sodium silicate, solution (60 deg.).....100 lb.	2.35 - 2.50	2.55 - 2.90
Sodium sulphate, crystals (Glauber's salt).....100 lb.	1.00 - 1.15	1.20 - 1.50
Sodium sulphide, fused, 60-62 per cent (conc.).....lb.	04½ - 04½	04½ - 05½
Sodium sulphite, crystals.....lb.	03½ - 03½	03½ - 04½
Strontium nitrate, powdered.....lb.	09 - 10	10½ - 12
Sulphur chloride, yellow.....lb.	04½ - 05	05½ - 06
Sulphur, crude.....ton	18.00 - 20.00	
Sulphur dioxide, liquid, cylinders extra.....lb.	08 - 08½	09 - 10
Sulphur (sublimed), flour.....100 lb.		2.25 - 3.10
Sulphur, roll (brimstone).....100 lb.		2.00 - 2.75
Talc—imported.....ton	30.00 - 40.00	
Talc—domestic powdered.....ton	18.00 - 25.00	
Tin bichloride.....lb.	09 - 09½	09½ - 10
Tin oxide.....lb.		35 - 37
Zinc carbonate.....lb.	14 - 14½	14½ - 15½
Zinc chloride, gran.....lb.	05½ - 06	06½ - 06½
Zinc cyanide.....lb.	42 - 44	45 - 47
Zinc oxide, XX.....lb.	07½ - 08	08½ - 08½
Zinc sulphate.....100 lb.	2.75 - 3.00	3.05 - 3.30

Coal-Tar Products

NOTE—The following prices are for original packages in large quantities:

Alpha-naphthol, crude.....lb.	\$1.00 - \$1.05
Alpha-naphthol, refined.....lb.	1.10 - 1.15
Alpha-naphthylamine.....lb.	30 - 31
Aniline oil, drums extra.....lb.	15 - 16
Aniline salts.....lb.	22 - 24
Anthracene, 80% n drums (100 lb.).....lb.	75 - 1.00
Benzaldehyde U.S.P.....lb.	1.25 - 1.30
Benzidine, base.....lb.	85 - 95
Benzidine sulphate.....lb.	75 - 85
Benzoic acid, U.S.P.....lb.	65 - 70
Benzoate of soda, U.S.P.....lb.	55 - 57
Benzene, pure, water-white, in drums (100 gal.).....gal.	29 - 35
Benzene, 90%, in drums (100 gal.).....gal.	27 - 32
Benzyl chloride, 95-97%, refined.....lb.	25 - 27
Benzyl chloride, tech.....lb.	20 - 23
Beta-naphthol benzene.....lb.	3.75 - 4.00
Beta-naphthol, sublimed.....lb.	50 - 55
Beta-naphthol, tech.....lb.	25 - 27
Beta-naphthylamine, sublimed.....lb.	1.50 - 1.60
Cresol, U. S. P., in drums (100 lb.).....lb.	12 - 15
Ortho-cresol, in drums (100 lb.).....lb.	16 - 18
Cresylic acid, 97-99%, straw color, in drums.....gal.	53 - 55
Cresylic acid, 95-97%, dark, in drums.....gal.	48 - 50
Dichlorobenzene.....lb.	06 - 09
Diethylaniline.....lb.	65 - 70
Dimethylaniline.....lb.	36 - 38
Dinitrobenzene.....lb.	22 - 25
Dinitrochlorobenzene.....lb.	22 - 24
Dinitronaphthalene.....lb.	30 - 32
Dinitrophenol.....lb.	33 - 35
Dinitrotoluene.....lb.	22 - 24
Dip oil, 25%, car lots, in drums.....gal.	24 - 26
Diphenylamine.....lb.	59 - 65
H-acid.....lb.	85 - 1.00
Meta-phenylenediamine.....lb.	90 - 1.00
Monochlorobenzene.....lb.	09 - 11
Monothylaniline.....lb.	1.05 - 1.25
Naphthalene crushed, in bbls.....lb.	06 - 06½
Naphthalene, flake.....lb.	06½ - 07
Naphthalene, balls.....lb.	08 - 08½
Naphthionic acid, crude.....lb.	65 - 70
Nitrobenzene.....lb.	10 - 12
Nitro-naphthalene.....lb.	30 - 35
Nitro-toluene.....lb.	15 - 17½
Ortho-amidophenol.....lb.	2.50 - 2.60
Ortho-dichlorobenzene.....lb.	15 - 20
Ortho-nitro-phenol.....lb.	70 - 75

Ortho-nitro-toluene.....	lb.	.12	—	.15
Ortho-toluidine.....	lb.	.16	—	.20
Para-amidophenol, base.....	lb.	1.25	—	1.30
Para-amidophenol, HCl.....	lb.	1.30	—	1.35
Para-dichlorobenzene.....	lb.	.14	—	.16
Paranitroaniline.....	lb.	.75	—	.77
Para-nitrotoluene.....	lb.	.60	—	.70
Para-phenylenediamine.....	lb.	1.50	—	1.55
Para-toluidine.....	lb.	1.05	—	1.15
Phthalic anhydride.....	lb.	.35	—	.38
Phenol, U. S. P., drums.....	lb.	.14	—	.15
Pyridine.....	gal.	1.75	—	2.75
Resorcinol, technical.....	lb.	1.30	—	1.35
Resorcinol, pure.....	lb.	1.75	—	1.80
Salicylic acid, tech. in bbls.....	lb.	.25	—	.25
Salicylic acid, U. S. P.....	lb.	.26	—	.26
Solvent naphtha, water-white, in drums, 100 gal.....	gal.	.25	—	.28
Solvent naphtha, crude, heavy, in drums, 100 gal.....	gal.	.10	—	.12
Sulphanilic acid, crude.....	lb.	.24	—	.26
Tolidine.....	lb.	1.20	—	1.30
Toluidine, mixed.....	lb.	.30	—	.35
Toluene, in tank cars.....	gal.	.25	—	.28
Toluene, in drums.....	gal.	.30	—	.35
Xylidines, drums, 100 gal.....	lb.	.40	—	.45
Xylene, pure, in drums.....	gal.	.40	—	.45
Xylene, pure, in tank cars.....	gal.	.45	—	—
Xylene, commercial, in drums, 100 gal.....	gal.	.33	—	.35
Xylene, commercial, in tank cars.....	gal.	.30	—	—

Waxes

Quotations same as previous report.

Naval Stores

All prices are f.o.b. New York unless otherwise stated, and are based on carload lots. The oils in 50-gal. bbls., gross weight, 500 lb.

Rosin B-D, bbl.....	280 lb.	\$5.15	—	\$5.20
Rosin E-I.....	280 lb.	\$5.25	—	\$5.30
Rosin K-N.....	280 lb.	\$5.35	—	\$5.50
Rosin W. G.-W. W.....	280 lb.	7.00	—	7.25
Wood rosin, bbl.....	280 lb.	6.25	—	—
Spirits of turpentine.....	gal.	.93	—	.93
Wood turpentine, steam dist.....	gal.	.85	—	—
Wood turpentine, dest. dist.....	gal.	.70	—	.70
Pine tar pitch, bbl.....	200 lb.	—	—	6.00
Tar, kiln burned, bbl. (500 lb.).....	bbl.	—	—	10.00
Retort tar, bbl.....	500 lb.	—	—	9.00
Rosin oil, first run.....	gal.	.36	—	—
Rosin oil, second run.....	gal.	.38	—	—
Rosin oil, third run.....	gal.	.46	—	—
Pine oil, steam dist., sp.gr. 0.930-0.940.....	gal.	1.90	—	—
Pine oil, pure, dest. dist.....	gal.	1.50	—	—
Pine tar oil, ref., sp.gr. 1.025-1.035.....	gal.	.46	—	—
Pine tar oil, crude, sp.gr. 1.025-1.035 tank cars f.o.b. Jacksonville, Fla.....	gal.	.35	—	—
Pine tar oil, double ref., sp.gr. 0.965-0.990.....	gal.	.75	—	—
Pine tar, ref., thin, sp.gr. 1.080-1.060.....	gal.	.35	—	—
Turpentine, crude, sp.gr. 0.900-0.970.....	gal.	1.25	—	—
Hardwood oil, f.o.b. Mich., sp.gr. 0.960-0.990.....	gal.	.35	—	—
Pine wood creosote, ref.....	gal.	.52	—	—

Fertilizers

Ammonium sulphate, f.a.s., N.Y.....	100 lb.	3.65	—	3.75
Blood, dried, f.o.b., N. Y.....	unit	3.55	—	3.65
Bone, 3 and 50, ground, raw.....	ton	27.00	—	28.00
Fish scrap, dom., dried, f.o.b. works.....	unit	3.10	—	3.20
Nitrate soda.....	100 lb.	2.85	—	2.90
Tankage, high grade, f.o.b. Chicago.....	unit	3.00	—	3.10
Phosphate rock, f.o.b. mines, Florida pebble, 68-72%.....	ton	3.50	—	3.75
Tennessee, 78-80%.....	ton	7.00	—	7.50
Potassium muriate, 80%.....	ton	31.00	—	33.00
Potassium sulphate.....	unit	1.00	—	—

Crude Rubber

Prices remain same as report of May 10.

Oils

VEGETABLE

The following prices are f.o.b. New York for carload lots.

Castor oil, No. 3, in bbls.....	lb.	\$0.10	—	\$0.10
Castor oil, AA, in bbls.....	lb.	.11	—	.12
China wood oil, in bbls.....	lb.	.14	—	.14
Coconut oil, Ceylon grade, in bbls.....	lb.	.08	—	.09
Coconut oil, Cochon grade, in bbls.....	lb.	.09	—	.09
Corn oil, crude, in bbls.....	lb.	.11	—	.11
Cottonseed oil, crude (f. o. b. mill).....	lb.	.10	—	.10
Cottonseed oil, summer yellow.....	lb.	.12	—	.12
Cottonseed oil, winter yellow.....	lb.	.13	—	.13
Linseed oil, raw, ear lots (domestic).....	gal.	.90	—	.91
Linseed oil, raw, tank cars (domestic).....	gal.	.86	—	.87
Linseed oil, in 5-bbl lots (domestic).....	gal.	.93	—	.94
Olive oil, denatured.....	gal.	1.15	—	1.17
Palm, Lagos.....	lb.	.07	—	.07
Palm, Niger.....	lb.	.06	—	.06
Peanut oil, crude, tank cars (f.o.b. mill).....	lb.	.10	—	.10
Peanut oil, refined, in bbls.....	lb.	.12	—	.13
Rapeseed oil, refined in bbls.....	gal.	.83	—	.84
Rapeseed oil, blown, in bbls.....	gal.	.87	—	.88
Soya bean oil (Manchurian), in bbls. N. Y.....	lb.	.11	—	—
Soya bean oil, tank cars, f.o.b., Pacific coast.....	lb.	.09	—	—

FISH

Light pressed menhaden.....	gal.	\$0.54	—	—
Yellow bleached menhaden.....	gal.	.57	—	—
White bleached menhaden.....	gal.	.56	—	—
Blown menhaden.....	gal.	.61	—	—

Miscellaneous Materials

All prices remain quotably unchanged.

Refractories

Quotations same as previous report.

Ferro-Alloys

Ferrocobalt-titanium, 15-18%, f.o.b. Niagara Falls, N. Y.....	net ton	\$200.00	—	\$225.00
Ferrocobalt, per lb. of Cr contained, 6-8% carbon, carlots.....	lb.	.11	—	—
Ferrocobalt, per lb. of Cr contained, 4-6% carbon, carlots.....	lb.	.12	—	—
Ferromanganese, 76-80% Mn, domestic.....	gross ton	67.00	—	69.00
Spiegelisen, 18-22% Mn.....	gross ton	34.00	—	35.00
Ferromolybdenum, 50-60% Mo, per lb. of Mo.....	lb.	2.00	—	2.25
Ferrosilicon, 10-15%.....	gross ton	38.00	—	40.00
Ferrosilicon, 50%.....	gross ton	56.00	—	58.00
Ferrosilicon, 75%.....	gross ton	115.00	—	120.00
Ferrotungsten, 70-80%, per lb. of contained W.....	lb.	.45	—	.50
Ferro-uranium, 35-50% of U, per lb. of U content.....	lb.	6.00	—	—
Ferrovanadium, 30-40% per lb. of contained V.....	lb.	3.00	—	3.50

Ores and Semi-finished Products

All f.o.b. New York, Unless Otherwise Stated

Bauxite, 52% Al content.....	net ton	\$6.00	—	\$12.00
Chrome ore, Calif. concentrates, 50% min. Cr ₂ O ₃	ton	19.00	—	20.00
Chrome ore, 50% Cr ₂ O ₃ , f.o.b. Atlantic seaboard.....	ton	19.00	—	20.00
Coke, foundry, f.o.b. ovens.....	net ton	6.75	—	7.00
Coke, furnace, f.o.b. ovens.....	net ton	6.25	—	6.50
Fluorspar, gravel, f.o.b. mines, New Mexico.....	net ton	12.00	—	—
Fluorspar, standard, domestic washed gravel Kentucky and Illinois mines.....	net ton	20.00	—	22.00
Ilmenite, 52% TiO ₂ , per lb. ore.....	lb.	.01	—	.01
Manganese ore, 50% Mn, c.i.f. Atlantic seaport.....	unit	.26	—	.27
Manganese ore, chemical (MnO ₂).....	net ton	60.00	—	65.00
Molybdenite, 85% MoS ₂ , per lb. of MoS ₂ , N. Y.....	lb.	.47	—	.50
Monasite, per unit of ThO ₂ , c.i.f. Atlantic seaport.....	unit	27.00	—	—
Pyrites, Spanish, fines, c.i.f. Atlantic seaport.....	unit	.12	—	.12
Pyrites, Spanish, furnace size, c.i.f. Atlantic seaport.....	unit	.13	—	.13
Pyrites, domestic, fines, f.o.b. mines, Ga.....	unit	.11	—	.12
Rutile, 95% TiO ₂ , per lb. ore.....	lb.	.12	—	—
Tungsten, scheelite, 60% WO ₃ and over, per unit of WO ₃ (nominal).....	unit	2.50	—	2.75
Tungsten, wolframite, 60% WO ₃ and over, per unit of WO ₃ , N. Y. C.....	unit	2.75	—	3.00
Uranium ore (carnotite) per lb. of U ₂ O ₅	lb.	1.25	—	1.75
Uranium oxide, 96% per lb. contained U ₂ O ₅	lb.	2.25	—	2.50
Vanadium pentoxide, 99%.....	lb.	12.00	—	14.00
Vanadium ore, per lb. of V ₂ O ₅ contained.....	lb.	1.00	—	—
Zircon, washed, iron free, f.o.b. Pablo, Florida.....	lb.	.04	—	.13

Non-Ferrous Metals

New York Markets

	Cents per Lb.
Copper, electrolytic.....	13.00
Aluminum, 98 to 99 per cent.....	19.00
Antimony, wholesale lots, Chinese and Japanese.....	5.50
Nickel, ordinary (ingot).....	36.00
Nickel, electrolytic.....	39.00
Nickel, electrolytic, resale.....	30.00-33.00
Monel metal, shot and blocks.....	32.00
Monel metal, ingots.....	35.00
Monel metal, sheet bars.....	38.00
Tin, 5-ton lots, Straits.....	30.625
Lead, New York, spot.....	5.25
Lead, E. St. Louis, spot.....	5.125
Zinc, spot, New York.....	5.525-5.55
Zinc, spot, E. St. Louis.....	5.025-5.05

OTHER METALS

Silver (commercial).....	oz.	\$0.70
Cadmium.....	lb.	1.15-1.20
Bismuth (500 lb. lots).....	lb.	2.00@2.10
Cobalt.....	lb.	3.00@3.25
Magnesium.....	lb.	1.05
Platinum.....	oz.	85.00
Iridium.....	oz.	150.00@170.00
Palladium.....	oz.	50.00@55.00
Mercury.....	.75 lb.	55.00

Industrial

Financial, Construction and Manufacturers' News

Construction and Operation

Arkansas

LITTLE ROCK—The Rose City Cotton Oil Mill Co. is planning for the rebuilding of the portion of its plant, recently destroyed by fire, with loss estimated at about \$45,000. Alfred Kahn is general manager.

FORT SMITH—The Twin City Glass Co. has commenced the construction of its proposed local plant, with main building 50x100 ft., to be equipped for the manufacture of bottles and other glass containers. It is proposed to commence production late in June, giving employment to about 100 operatives. Harry Hart is president.

California

GLENDALE—The International Chemical Products Co., 710 East Broadway, has awarded a contract to the R. L. Kent Co., 130 South Brand Blvd., for the construction of a first unit for a new plant on property recently acquired on West Colorado St., comprising about 2½ acres of land. The structure will be 2-story, 25x100 ft., and will be supplemented with other units at a later date. The plant will be equipped for the manufacture of special printing inks and kindred products. George W. Strang is general manager.

Connecticut

ELMWOOD—The Park Brick Co., Elmwood, near Hartford, is considering plans for the rebuilding of its plant, destroyed by fire April 29, with loss approximating \$150,000, including equipment.

Idaho

COEUR D'ALENE—The Callahan Zinc-Lead Co., 61 Broadway, New York, N. Y., is reported to be planning for the purchase of local property, for which negotiations are now under way, for the establishment of a new plant. The company has secured options on the property of the Marsh Mining Co., in the Hecla district, and proposes extensive operations in this section.

Illinois

ROCK ISLAND—The Service Rubber Co., 401 Central Trust Bldg., has plans nearing completion and will take bids late in May for the construction of a new 3-story plant, 60x300 ft., on local site, estimated to cost about \$100,000 with machinery. Cervin & Horn, 311 Safety Bldg., are architects. J. T. Crowley heads the company.

Indiana

ELWOOD—The Macbeth-Evans Glass Co., Chamber of Commerce Bldg., Pittsburgh, Pa., is completing plans for extensions and improvements in its local plant to cost about \$35,000. Work will be commenced at an early date.

GARY—The National Tube Co., Frick Bldg., Pittsburgh, Pa., a subsidiary of the United States Steel Corp., has plans nearing completion for the construction of its proposed new plant on the Lake Front. Gary, recently authorized by the parent organization; work will begin at an early date. The new steel mill will consist of a series of buildings, estimated to cost close to \$15,000,000, with machinery. William B. Schiller is president; R. C. Patterson is chief engineer in charge.

Iowa

MARSHALLTOWN—The City Council has preliminary plans under way for the construction of a new filtration plant at the municipal waterworks. O. G. Herm is city engineer.

Louisiana

STERLINGTON—The Federal Petroleum Co., Monroe, La., has acquired property on the Ouachita River, Sterlington, for the construction of a new assembling and distributing plant. The company purposes ex-

tensive operations in this vicinity, and will develop a large refined oil output.

MONROE—The Southwest Pulp & Paper Co., 342 Madison Ave., New York, N. Y., will take bids during June and July for considerable equipment for installation at its proposed new plant on the Monroe-Columbia Highway. The initial works will aggregate about 70,000 sq.ft., and will be equipped for an output of approximately 100 tons of refined pulp per day. A power plant will also be erected. The new mill is estimated to cost close to \$250,000. Joseph G. Mayo is president and managing director, with headquarters at 206 Broadway, Norwich, Conn.

Maryland

EASTON—The New Brick & Tile Co., Moreland Bldg., recently organized with a capital of \$50,000, will take bids at once for the construction of its proposed new 1-story plant on local site for the manufacture of brick, drain tile and other burned clay products. It will cost about \$42,000, including equipment. J. Fletcher Clark is secretary and treasurer.

BALTIMORE—The Baltimore Gas Appliance & Mfg. Co., Bayard and Hamburg Sts., is considering plans for the construction of an addition to be equipped as a porcelain-enameling department. H. W. Hunter is president.

Massachusetts

CAMBRIDGE—The Whittemore Brothers Corp., Albany St., has awarded a contract to the Scully Co., East Cambridge, for the rebuilding of the portion of its polish manufacturing plant, recently destroyed by fire. The new structure will cost approximately the amount of the fire loss, \$65,000, and work will be commenced at once.

Michigan

BENTON HARBOR—The City Council has plans under way for the construction of a new filtration plant at the municipal waterworks. Pearce, Greeley & Hansen, 39 West Adams St., Chicago, Ill., are engineers.

DETROIT—The Detroit Sand Lime Brick Co., 507 Vinton Bldg., will soon commence the construction of its proposed new plant on property lately acquired on the Oakwood side of the River Rouge, comprising about 16 acres of land. The main structure will be 125x400 ft. A portion of the machinery installation will be of special type. William Niemann is secretary and treasurer.

Mississippi

WOODVILLE—The Dampf & Morgan Co. has acquired the property of the Woodville Oil Mill, and plans to convert the structure for a paper mill. Plans are being prepared for a number of improvements and alterations.

New Jersey

TRENTON—Lenox, Inc., Mead St., manufacturer of fine chinaware, has awarded a contract to the Karno-Smith Co., Trenton, for the erection of a 1-story building at its plant.

PASSAIC—The Paterson Parchment Paper Co., 6th St., has commenced the erection of a new 2-story plant extension, 40x120 ft., to be used for general operating service. It will cost about \$50,000. The Solomon-Abbott Co., 175 Fifth Ave., New York, N. Y., is engineer.

PATERSON—Fire, May 1, destroyed a portion of the plant of the Olive Oil Soap Co., 85 Fulton St., with loss reported in excess of \$100,000, including building, equipment and materials.

New York

POUGHKEEPSIE—The Corrugated Rubber Co., 25 West 43rd St., New York, will take bids at once for the erection of the first unit of its proposed plant in the Fairview section, Poughkeepsie, to be 1-story, 60x200 ft., and estimated to cost about \$90,000, including machinery. W. L. Fairchild is general manager. W. J. Beardsley, 49 Market St., Poughkeepsie, is architect.

NEW YORK—The American Smelting & Refining Co., 120 Broadway, is arranging an appropriation of \$750,000, for extensions and betterments at its Colorado properties, including the installation of new equipment. The work will include the construction of an addition to the smelting plant at Durango, to cost approximately \$250,000, and improvements in the Rawley properties near Salida, to cost \$100,000.

OLEAN—The Vacuum Oil Co., 61 Broadway, New York, will commence the immediate erection of the superstructure at its plant additions at Olean, comprising a number of buildings, estimated to cost about \$500,000, including equipment. The White Construction Co., 95 Madison Ave., has the building contract.

BROOKLYN—A. Aron, 335 Johnson Ave., has awarded a contract to Thomas Drysdale, 250 Baltic St., for the erection of a 3-story fat rendering plant, 50x70 ft., estimated to cost about \$25,000. Joseph Himelbach, 136 Liberty St., New York is engineer.

ENDICOTT—The Binghamton Limestone Co., care of the Kellogg-Jones Co., O'Neill Bldg., Binghamton, has preliminary plans under way for the erection of a new plant on site selected at Endicott, for the manufacture of brick and kindred products.

North Carolina

CHARLOTTE—The Virginia-Carolina Chemical Co., Richmond, Va., has plans under way for the erection of a new local plant for the manufacture of fertilizer products.

Ohio

SALEM—The Sumatra Rubber Specialty Co., recently organized, has acquired a local building and will install machinery at once for the manufacture of rubber goods of various kinds.

YOUNGSTOWN—The Newton Steel Co., manufacturer of steel sheets, etc., is considering tentative plans for the construction of a series of new sheet mills, comprising about 6 individual units, estimated to cost about \$750,000 with machinery.

LANCASTER—The Fairfield Glass Co. has preliminary plans under consideration for the construction of a new local plant for window glass manufacture, consisting of a number of buildings, estimated to cost in excess of \$2,000,000. Leopold Hambourg is general manager.

CLEVELAND—The Industrial Fibre Co. of America, Waldorf Ave., S. W., and West 98th St., has filed plans for the erection of a 3-story and basement addition, 84x100 ft., estimated to cost about \$60,000. Work will be placed under way at once.

Oklahoma

SHIDLER—The Phillips Petroleum Co., Bartlesville, has work nearing completion on a new gasoline-extraction plant, estimated to cost close to \$1,000,000, and forming one of the largest works of its kind in the country. Operations will be commenced in the first 13 units at an early date; more units will be constructed at a later date, with installation to comprise gas engines, air compressors, etc.

Pennsylvania

PITTSBURGH—The Fleischmann Co., 701 Washington St., New York, N. Y., has acquired property at Western and Allegheny Aves., 75x192 ft., for a consideration of \$25,000, as a site for the erection of its proposed new yeast-manufacturing plant, to be 3-story and estimated to cost about \$100,000, including equipment. It is planned to commence construction early in the summer.

PHILADELPHIA—The Powers-Weightmann-Rosengarten Co., Moore and 35th Sts., manufacturer of chemicals, has filed plans for the erection of an addition to its plant, 2-story, 42x80 ft., estimated to cost about \$16,000.

NEW CUMBERLAND—The New Cumberland Paper Co. will commence the immediate erection of a new 1-story plant on local site, 60x90 ft. The building contract has been let to Harry Hollacher, New Cumberland.

PHILADELPHIA—The Nustone Products Corp., 3450 Richmond St., manufacturer of sanitary products, ware, etc., has awarded a contract to John M. Yardley, 1716 Sansom St., for the erection of a new 1-story plant, 140x192 ft., on Schiller St., near Allen Ave. Work will be commenced at once. Ritter & Shay, North American Bldg., are architects.

Tennessee

GALLATIN—The City Council has plans under way for the construction of a new

filtration plant at the waterworks. W. H. Bryce, First National Bank Bldg., is consulting engineer.

Texas

LUBBOCK—The Quana Cotton Oil Co. has completed plans for the first buildings for its new cotton oil mill, and will commence erection at an early date. The plant will be of 4-press type. Other units will be constructed at a later time.

MARSHALL—The Marshall Brick Co. will commence the immediate installation of new machinery at its plant for the manufacture of dry-pressed brick, forming a new department for this branch of production. The initial capacity will be about 20,000 bricks per day, and which will be increased at a later date.

SHERMAN—The oil refinery of the Buffalo Oil & Producing Co., South Sherman, has been acquired by F. M. Thompson, C. C. Mayhew and associates, all of Sherman, at a receiver's sale. The new owners will organize a company and operate the plant. A number of improvements will be made.

Virginia

NORFOLK—The Robertson Fertilizer Co. has awarded a contract to the Chemical Construction Co., Charlotte, N. C., for the rebuilding of its plant at Money Point, destroyed by fire several months ago. Work will be placed under way at once.

Washington

KENNYDALE—The Republic Creosoting Co. is arranging for the immediate rebuilding of the portion of its plant on Lake Washington, recently destroyed by fire. F. C. Powell is general manager.

West Virginia

THOMAS—The City Council is planning for the installation of a new waterworks system, including a filtration plant. Bonds will soon be voted.

CHARLESTON—The Warner - Klipstein Chemical Co., comprising a recent merger of the Warner Chemical Co. and the E. C. Klipstein & Sons Co., has plans under way for extensions in its plant for considerable increase in capacity. F. J. Kaufman is resident manager.

Capital Increases, etc.

THE CENTRAL GLASS WORKS, INC., Charleston, W. Va., has filed notice of increase in capital from \$500,000 to \$600,000.

THE SPECIALTY RUBBER WORKS, Hackett St., Newark, N. J., has filed notice of change of name to the Goodyear Rubber Mfg. Co.

THE PLANTATION CONSOLIDATED OIL CORP., Bowling Green, Ky., has filed notice of increase in capital from \$150,000 to \$350,000.

THE UNION OIL CO. OF CALIFORNIA, Union Oil Bldg., Los Angeles, Cal., is disposing of a bond issue of \$10,000,000, the proceeds to be used for general operations, financing, expansion, etc. W. L. Stewart is president.

THE SIZER STEEL CORP., Buffalo, N. Y., has arranged for a bond issue of \$1,250,000, the proceeds to be used for general expansion, operations, etc. The company has recently acquired the plant of the Hammond Steel Co., Syracuse, N. Y. C. B. Porter is president.

THE NATIONAL ZINC CO., 61 Broadway, New York, N. Y., has filed notice of dissolution under state laws.

THE DIXIE BELL REFINING CO., Louisville, Ky., has filed notice of change of name to the Louisville Refining Co., to operate oil refineries.

THE AMERICAN WOODPULP CORP., 347 Madison Ave., New York, N. Y., has filed notice of increase in capital from \$70,000 to \$370,000.

THE HURRICANE IRON & MINING CO., Columbia, Tenn., has filed notice of increase in capital from \$60,000 to \$100,000.

COSDEN & CO., 120 Broadway, New York, operating oil refineries in the mid-continent field, Okla., has arranged for a preferred stock issue of \$3,252,900, the proceeds to be used for general operations, expansion, financing, etc.

The receiver for the **ZEE ZEE RUBBER CO.**, Yardville, N. J., is arranging for the sale of the plant of the company.

THE LAMBERSON JAPANING CO., 2334 West Kinzie St., Chicago, Ill., has filed notice of increase in capital from \$5,000 to \$150,000.

The receiver for the **STOCKTON RUBBER CO.**, Trenton, N. J., will dispose of the plant and property of the company.

New Companies

THE JOHNSON PRODUCTS CO., Newark, N. J., has been incorporated with a capital of \$500,000, to manufacture celluloid specialties and other composition products. The incorporators are Frank E. Horace C., Jr., and Charles J. Johnson, 138 Paris St.

THE OVERBROOK GLASS BOTTLE CO., Jeannette, Pa., has been incorporated with a capital of \$50,000, to manufacture glass products. S. H. Grimes, Jeannette, is treasurer.

THE ALLEN RUBBER CO., Boston, Mass., has been incorporated with a capital of 1,000 shares of stock, no par value, to manufacture rubber goods. Charles Langmaid is president; and Max Laserson, Fabian St., Dorchester, Mass., treasurer.

THE LINN PRODUCTS CO., 125 South Jefferson St., Chicago, Ill., has been incorporated with a capital of \$35,000, to manufacture soaps, washing powders, etc. The incorporators are Robert White, Leon Hamburger and Perrin C. Miller.

THE GREENVILLE PAPER CO., Greenville, S. C., has been incorporated with a capital of \$20,000, to manufacture paper products. J. W. Keys is president; W. S. Mills, vice-president; and J. C. Keys secretary, all of Greenville.

EUGENE SUTER & CO., INC., New York, N. Y., has been incorporated with a capital of \$400,000, to manufacture chemicals, chemical byproducts, drugs, etc. The incorporators are Eugene Suter, F. Russell and H. C. Tomlinson, Jr. The company is represented by A. C. Cox, Jr., 15 Broad St., New York.

GRUESNER'S, INC., New Brunswick, N. J., has been incorporated with a capital of \$50,000, to manufacture chemicals and chemical byproducts. The incorporators are Alexander and Anthony Gruesner, 4 French St., New Brunswick.

THE NAUGATUCK TIRE & RUBBER CO., Wilmington, Del., has been incorporated with a capital of \$1,500,000, to manufacture automobile tires and other rubber products. The company is represented by the Corporation Service Co., Equitable Bldg., Wilmington.

THE POPE CHEMICAL CO., Boston, Mass., has been incorporated with a capital of \$5,000, to manufacture chemicals and chemical byproducts. Nicholas DuVally is president; and A. B. DuVally, 57 Cambridge St., Boston, treasurer.

THE TEXAS-MEXICAN OIL AND REFINING CO., Lardo, Tex., has been incorporated with a capital of \$125,000, to manufacture refined petroleum products. The company has preliminary plans under way for the construction of a refinery on local site. J. N. Galbraith is president; Miles T. Cogley, vice-president; and J. N. Galbraith, Jr., secretary, all of Lardo.

THE GIRARD PAINT CO., Girard, O., has been incorporated with a capital of \$25,000, to manufacture paints, varnishes, etc. The incorporators are J. H. Drage and F. H. Bushong, both of Girard.

THE ALUMINO THERMIC CORP., 15 Exchange Place, Jersey City, N. J., has been incorporated with a capital of \$300,000, to manufacture chemicals and chemical byproducts. The incorporators are Hugh G. Spillsbury, Charles H. Hunter and Merle I. St. John.

THE CENTURY PAPER CO., Indianapolis, Ind., has been incorporated with a capital of \$30,000, to manufacture paper products. The incorporators are H. A. Rowley, W. N. Gillett and Robert W. Fleischer, all of Indianapolis.

THE OIL PRODUCERS REFINING CO., New Castle, Del., has been incorporated under state laws, with a capital of \$40,000, to manufacture refined oil products. The incorporators are M. M. Toner, New Castle; G. H. Reed and R. L. Spurgeon, Wilmington, Del. The company is represented by the Corporation Guarantee & Trust Co., Land Title Bldg., Philadelphia, Pa.

THE ASHLEY-BEHRENS MFG. CO., 3370 Grand River Ave., Detroit, Mich., has been incorporated with a capital of \$20,000, to manufacture waxes, varnishes and kindred products. The incorporators are G. Leon Ashley, Wilbur J. Behrens and Norman F. Thomsen.

THE MONITOR PAINT & CHEMICAL CO., 88 North St., Boston, Mass., has filed notice of organization to manufacture chemical specialties. John V. O'Donnell heads the company.

THE HARLAND OIL CO., Wilmington, Del., has been incorporated under state laws, with capital of \$1,000,000, to manufacture petroleum products. The company is represented by the Corporation Trust Co. of America, du Pont Bldg., Wilmington.

THE L. & P. DENNIS & SON CO., 926 Main St., Crisfield, Md., has been incorporated with a capital of \$100,000, to manufacture fertilizer products. The incorporators are E. Benson Dennis, James H. Sterling and William M. Wooster.

THE PARAMOUNT PAINT & VARNISH CO., Brooklyn, N. Y., has been incorporated with a capital of \$5,000, to manufacture paints, varnishes, etc. The incorporators are S. V. and M. Isaacs. The company is represented by Levinson & Feinsod, 277 Broadway, New York.

THE NATIONAL INK WORKS, INC., Camden, N. J., has been incorporated with a capital of \$100,000, to manufacture ink and affiliated products. The incorporators are Edward F. Dennis, Edmund Kirkbridge and Joseph A. McHenry, Jr. The company is represented by Rudolph S. Ayers, 428 Market St., Camden.

THE AMERICAN ANILINE WORKS, INC., Philadelphia, Pa., has been incorporated with a capital of \$25,000, to manufacture chemicals, dyes and kindred products. G. L. Armour, 455 West End Ave., New York, N. Y., is treasurer.

THE GARDINER-MCKINNES CO., New York, N. Y., has been incorporated with a capital of \$121,000, to manufacture chemicals, chemical byproducts, paints, etc. The incorporators are B. and G. N. Gardiner and J. P. Green. The company is represented by Phillips & Abery, 41 Park Row, New York.

THE LOCAL REFINING CORP., Oklahoma City, Okla., has been incorporated with a capital of \$20,000, to manufacture refined petroleum products. The incorporators are M. H. Davis, R. L. Edwards and D. B. Richardson, all of Oklahoma City.

THE JACKSON MFG. CO., Trenton, N. J., has been incorporated with a capital of \$150,000, to manufacture leather products. The incorporators are Maurice and Saul Black. The company is represented by Alexander Trapp, 147 East State St., Trenton.

THE CRESCENT CHEMICAL CO., Boston, Mass., has filed notice of organization to manufacture chemicals and chemical byproducts. The company is headed by Michael J. Cavanaugh and Frank E. Lanagan, 1041 Washington St., Boston.

THOMAS SEALY, INC., New York, N. Y., has been incorporated with a capital of \$400,000, to manufacture chemicals, chemical byproducts, paints, etc. The incorporators are Thomas Sealy, W. J. Doyle and L. M. Vandolen. The company is represented by Pallister, Greene & O'Connell, 233 Broadway, New York.

THE RICHARDSON OIL CO., 102-104 South Front St., Quincy, Ill., has been incorporated with a capital of \$50,000, to manufacture oil products. The incorporators are John T. and E. Dean Richardson, and James A. Johnson.

THE RUWART MFG. CO., Jefferson City, Mo., has been incorporated with a capital of \$250,000, to manufacture leather products. The incorporators are Henry, Joseph E., and William Ruwart, all of Jefferson City.

THE PURITAN OIL & SOAP CO., Boston, Mass., has filed notice of organization to manufacture soaps, oils and affiliated products. Alfred Boggild, 215 Endicott St., Boston, heads the company.

Industrial Notes

DWIGHT P. ROBINSON & CO., New York, announce that a contract has been awarded them for the construction of a building to accommodate American commercial exhibits at the Brazilian Centennial Exposition to be held in Rio de Janeiro beginning Sept. 7. The building, which will be the "unofficial" exhibit building, will be constructed of American materials as far as possible. It will be purely a commercial proposition, having no direct connection with the exhibition plans of the American Government under the appropriation of \$1,000,000 made by Congress recently.

THE PFAUDLER CO., Rochester, N. Y., announces that on May 1 its New York office was moved to Room 1103, 8 West 40th St.

THE BETHLEHEM FOUNDRY & MACHINE CORP. announces that on May 1 it moved to Room 1716, Grand Central Terminal, New York City.

THE WESTINGHOUSE ELECTRIC & MFG. CO. announces the reorganization of the supply sales department and the establishment of a merchandising sales department, which are the major changes in the organization, according to announcement made recently by H. D. Shute, vice-president of the company. The changes, which entail the promotion and transfer of a number of officers,

were effective May 1, at which time the new merchandising sales department began to function. J. J. Gibson, manager of the supply sales department, becomes assistant to vice-president in the new plant of organization. In his new position Mr. Gibson will have general supervision over the activities of both the supply sales department and the new merchandising sales department. A. A. Brown is appointed manager of syndicate operation; J. S. Tritle, manager of the St. Louis office of this company, becomes manager of the merchandising sales department; T. J. Pace, assistant manager of the supply department, becomes manager of the supply sales department; C. E. Allen, manager of the central station division of the Chicago office, becomes manager of the St. Louis office, succeeding Mr. Tritle; George Baily, assistant to the manager of the supply department, becomes supervisor of distributing agents; A. C. Morrow, assistant sales manager of the Westinghouse Electric Products Co., becomes assistant to the manager of the merchandising sales department, and J. J. Dorney, manager of the industrial division, St. Louis office, becomes assistant to the manager of the merchandising department.

THE REPUBLIC CARBON CO., INC., announces that its offices, including the sales office, have been moved to Milwaukee, Wis. The plant remains at Niagara Falls, N. Y., the only change being that of concentrating the executive forces in one office.

THE ALBERGER CHEMICAL MACHINERY CO., INC., has moved its general offices from Grand Central Palace to 103 Park Ave., New York City.

THE DARCO CORP. of Wilmington, Del., announces that all sales of Darco and other refining materials manufactured by this company will be handled through the Darco Sales Corp., 45 East 42nd St., New York City.

THE GENERAL CHEMICAL CO. has moved its New York office from 25 Broad St. to 40 Rector St.

Manufacturers' Catalogs

THE CALLOW ROCK LIME CO., LTD., 810 Salisbury House, London, England, has issued a pamphlet on "Chemical Lime." Pages 1 to 16 deal generally with the use of lime in the chemical industry, while the last 16 pages deal with the production and the chemical and physical properties of Callow Rock lime products. Copies will be sent on request.

THE DAYTON-DOWD CO., Quincy, Ill., calls attention to its latest bulletin covering Type CSU multi-stage automatically balanced centrifugal pumps. The booklet is well illustrated.

THE WESTERN WHEELED SCRAPER CO., Aurora, Ill., announces the publication of Catalog 50, on "Dump Cars and Machinery for Handling Earth and Stone." This attractive 160-page catalog is in three sections. The first section illustrates and describes dump cars, railroad trestle filling, railroad ditching, industrial haulage, levee and dam construction and coal storage; in the second section (the contractors' equipment section) elevating graders, dump wagons, scrapers and plows are illustrated and described, while the third section deals with road graders, planer attachments, track crushers, hatch-boxes and industrial railways.

INGERSOLL-RAND CO., New York, in Bull. 10,004, describes Price type "PO" horizontal, single cylinder, single acting, direct-injection oil engine. Probably the most outstanding feature of the design of these engines is the shape of the combustion chamber and the arrangement and construction of the spray nozzles used for direct injection of fuel. With this system fuel injection and complete atomization are obtained without the use of high-pressure air, the ignition being at all times by the heat of compression only. Other noteworthy features are inclosed and oil-tight crank case; the pressure lubrication system for oiling all important bearings including cam rollers; the continuous filtration of lubricating oil; and the completely water-jacketed cylinder barrel and heads.

THE AMERICAN ATMOS CORP., New York City, has issued an interesting bulletin on the Paul breathing apparatus, which is illustrated and described.

THE HARDINGE CO., New York, has issued a new condensed bulletin on the Hardinge conical mill. This bulletin covers in a very concise manner the principle of operation of the mill, its adaptability to industrial and metallurgical grinding problems, and gives general dimensions covering the different types of mills, as well as tables showing sizes, powers, and capacities for different conditions of grinding.

Industrial Developments

CERAMIC—The Standard Sanitary Mfg. Co., Pittsburgh, Pa., has increased production by about 25 per cent at its Tiffin, O., plant during the past fortnight, giving employment to additional workers. Fires have been started in four additional kilns. A night schedule has been placed in operation in certain departments in addition to the regular day working basis.

The Hazleton Brick Co., Hazleton, Pa., is arranging for the immediate resumption of operations at its plant, following a shut-down for a number of months past.

The George J. Markley Co., Mineral City, O., has inaugurated a capacity schedule at its two local clay products plant. Employees have been granted an increase in wages of 5 cents an hour.

The Thomas Maddock's Sons Co., Trenton, N. J., manufacturer of sanitary ware, is running on a full time, full capacity basis, with regular working force. The company is said to have orders on hand to insure this rate of output for a number of months to come.

Manufacturers of clay sewer pipe at Urichsville, O., have advanced the working schedule at their plants from a 9- to 10-hour day basis.

LEATHER—The Dunn-Green Tannery, Hudson, Mass., is arranging for the early resumption of operations at its plant for the production of chrome side leathers.

The Murray Leather Co., Woburn, Mass., has adopted a capacity basis of operation, on a schedule of 1,500 sides of high-grade leather daily.

The American Hide & Leather Co. has resumed operations at its plant at Lowell, Mass., following a shut-down for a number of weeks past.

RUBBER—The Republic Rubber Corp., Youngstown, O., has increased operations at its plant since the first of the month to double the operating capacity of previous weeks. A three-shift schedule has been adopted in the inner tube manufacturing department, succeeding a two-shift operating basis, while a double shift basis has been inaugurated in the truck tire department instead of single shift, as heretofore.

The Keystone Tire & Rubber Co., New York, N. Y., is operating at maximum capacity at its plant, and plans to soon run on an overtime schedule, on a basis of three 8-hour shifts.

The Studebaker-Wulff Rubber Co., Marion, O., is arranging for an immediate advance in production at its plant; the working force will be increased. During the past fortnight the company has booked orders for 15,000 casings and 18,000 inner tubes.

Tire plants at Akron, O., are running on a normal basis, with total production approximating 30,000 tires a day. A call has been issued for 1,000 additional skilled workers at once, divided among the different mills. It is expected that the "peak" production period of 1920 of 100,000 tires daily in this district will be reached early in July.

OIL—The Standard Oil Co. has resumed operations at the lubricating oil unit of its refinery at Wood River, Ill., which has been closed down since last July.

The Sinclair Oil Corp., New York, N. Y., is increasing operations at its different oil-field properties and oil refineries.

IRON AND STEEL—The Minnesota Steel Co. has placed its blast-furnaces and open-hearth plant at Duluth, Minn., in operation. Production will soon begin at the new sheet mills, now nearing completion.

The Midvale Steel & Ordnance Co., Philadelphia, Pa., is arranging plans to blow in its blast furnace at Coatesville, Pa., on May 22, which has been idle for some time.

The Hydraulic Steel Co. has resumed operations at its sheet mill at Canton, O., following a protracted idleness.

The Shelby Iron Co., Birmingham, Ala., is arranging for the early resumption of operations at its furnace, now undergoing repairs.

The Tennessee Coal, Iron & Railroad Co., Birmingham, Ala., is running on a full 100 per cent basis, and will maintain this schedule for an indefinite period.

The McKinney Steel Co., Cleveland, O., has resumed operations at six open-hearth furnaces, developing close to normal production.

The Wickwire-Spencer Steel Corp., Buffalo, N. Y., is arranging for early increase in operations at its plant, now running at about 70 per cent of normal.

METALS—The American Smelting & Refining Co. has resumed operations at its smelter at Hayden, Ariz. The copper de-

partment of the company's smelting plant at El Paso, Tex., has also been placed in service. Four out of five of the company's smelters in Mexico are now in operation.

MISCELLANEOUS—The Smet-Solvay Co. has placed 60 additional coke ovens in operation at its plant at Birmingham, Ala. The bulk of distribution is to the furnaces of the Republic Iron & Steel Co.

The Enamel Products Co., Elyria, O., has adopted a capacity schedule at its plant, with orders on hand to insure production for a number of months on this basis.

Coming Meetings and Events

AMERICAN ASSOCIATION FOR THE ADVANCEMENT OF SCIENCE will hold a joint meeting with the Pacific Division of the Association, on the occasion of the annual meeting of the latter, in Salt Lake City, June 22 to 24.

AMERICAN ASSOCIATION OF ENGINEERS will hold its eighth annual convention at Salt Lake City, Utah, June 4-6.

AMERICAN CHEMICAL SOCIETY will hold its fall meeting in Pittsburgh, Pa., Sept. 5 to 9.

AMERICAN ELECTROCHEMICAL SOCIETY will hold its fall meeting in Montreal, Sept. 21, 22 and 23. Headquarters will be at the Windsor Hotel.

AMERICAN FOUNDRYMEN'S ASSOCIATION will hold its next convention and exhibit at Rochester, N. Y., during the week of June 5, 1922. Meetings will be held in the spring instead of in the fall as heretofore.

AMERICAN INSTITUTE OF CHEMICAL ENGINEERS will hold its summer meeting at Niagara Falls, Canada, June 19 to 22. Headquarters will be at the Clifton Hotel.

AMERICAN LEATHER CHEMISTS ASSOCIATION will hold its nineteenth annual meeting at Bigwin Inn, Bigwin Island, in the Lake of Bays district, Ontario, Canada, on June 21, 22 and 23.

AMERICAN OIL CHEMISTS' SOCIETY will hold its annual meeting at the Grunewald Hotel, New Orleans, La., June 5 and 6.

AMERICAN PULP AND PAPER MILL SUPERINTENDENTS ASSOCIATION will meet in Kalamazoo, Mich., June 1, 2 and 3.

AMERICAN SOCIETY FOR STEEL TREATING will hold a sectional meeting at the Bureau of Mines auditorium, Pittsburgh, Pa., on May 25 and 26. The International Steel Exposition and Convention of the society will be held in the General Motors Bldg., Detroit, Mich., Oct. 2 to 7.

AMERICAN SOCIETY FOR TESTING MATERIALS will hold its twenty-fifth annual meeting June 26 to July 1, at Atlantic City, N. J. Headquarters will be at the Chalfonte-Haddon Hall Hotel.

ANNUAL SAFETY CONGRESS OF THE NATIONAL SAFETY COUNCIL will be held in Detroit, Mich., Aug. 28-Sept. 2.

CERAMIC SOCIETY (London) is to have a foreign trip to Sweden and Denmark from May 27 to June 10.

CHAMBER OF COMMERCE OF THE UNITED STATES is holding its tenth annual meeting in Washington, D. C., May 15 to 18.

INTERNATIONAL UNION OF PURE AND APPLIED CHEMISTRY will hold a meeting at Lyons, France, June 27 to 30.

NATIONAL ASSOCIATION OF PURCHASING AGENTS EXPOSITION (the "Informashow") will be held in connection with the seventh annual convention of the association at Exposition Park, Rochester, N. Y., May 15-22.

NATIONAL COAL ASSOCIATION will hold its annual meeting at Congress Hall, Chicago, May 24-25.

NATIONAL EXPOSITION OF CHEMICAL INDUSTRIES (EIGHTH) will be held in New York Sept. 11-16.

NATIONAL EXPOSITION OF POWER AND MECHANICAL ENGINEERING will be held at the Grand Central Palace Dec. 7-13, with the exception of the intervening Sunday.

NATIONAL FERTILIZER ASSOCIATION will hold its twenty-ninth annual convention at the Greenbrier, White Sulphur Springs, W. Va., the week of June 12.

NEW JERSEY CHEMICAL SOCIETY will meet at Stettens Restaurant, 842 Broad St., Newark, N. J., the second Monday of every month.

STAMFORD CHEMICAL SOCIETY, Stamford, Conn., holds a meeting in the lecture room of the local high school on the fourth Monday of each month, except June, July, August and September.

The following meetings are scheduled to be held in Rumford Hall, the Chemists' Club, New York: May 19—Society of Chemical Industry, regular meeting; June 9—American Chemical Society, regular meeting.